STRUCTURAL ADJUSTMENT, INCOME DISTRIBUTION AND THE ROLE OF GOVERNMENT:

Theory, and Evidence from Brazil

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To my wife,

Bernice Karola van Bronkhorst

Abstract

This thesis discusses the impacts of some policies associated with structural adjustment on the distribution of incomes. It consists of three parts. An institutional chapter surveys and assesses the evolution of views on international debt and adjustment in the economics profession in the late 1970s and in the 1980s, with a special focus on the World Bank's contribution. This chapter provides a general historical background to the more specific models and case studies that follow.

A theoretical part considers the long term implications for income distribution of the post-adjustment permanent reduction in the role of government in the public provision of some important inputs, such as health care, education and infrastructure. Chapter 3 derives an endogenous steady-state wealth distribution which is used to investigate the consequences of changes in public investment for equality of opportunity in a world with imperfect capital markets. Chapter 4 considers various policy options for a benign government in that context and discusses comparative statics properties of its optimal size. Chapter 5 extends the analysis into a context with steady-state growth in per-capita incomes and focuses on long-run behavioural consequences of a smaller government when the poor are more dependent on public investment than the rich. Saving behaviour and hence rates of capital accumulation are shown to differ, with persistent inequality-augmenting effects.

Finally, the empirical part describes the evolution of the distribution of income - and of some poverty indicators - in Brazil during the 1980s. Using a large repeated cross-section household survey data set, the final two chapters demonstrate the increases in inequality during this period of failed stabilization policies, by means of scalar measures and of a battery of stochastic dominance results. The sensitivity of the inequality (and poverty) measures to variations in the equivalence scale used to compare incomes is investigated. Possible explanations for the behaviour of inequality are suggested by means of static and dynamic decompositions by recipient subgroups, and by some simple but intuitively appealing correlations and regressions on basic macroeconomic variables.

Table of Contents

List of Tables

List of Figures

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Among the above, I must single out Julie Litchfield, who co-authors the paper versions of Chapters 7 and 8. The empirical study of Brazilian income distribution which is reported here would not have been possible without her data processing and computing skills, all-round competence, thoughtfulness, enthusiasm and good will.

Naturally, I take full responsibility for any errors remaining in the thesis.

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CHAPTER 1

INTRODUCTION

1) Preliminaries.

In the 1980s, stabilization and structural adjustment programmes, designed to restore internal and external macroeconomic equilibria and to improve the efficiency with which resources are allocated in an economy, were implemented in a large number of developing countries. These programmes arose as a response to a combination of severe external shocks and accumulated policy problems which afflicted these various countries, albeit to different extents.

The 1980s also saw a marked deterioration in a number of performance indicators in less developed countries (LDCs). Growth in per capita incomes was generally low: 1.7% for all LDCs, 0.7% for all low income countries except China and India, 0.8% for middle-income economies, and -0.5% for Latin America and the Caribbean, in the period 1980-89 (see World Bank, 1981, 1991.). The ratio of investment to GNP fell in many countries and, in many cases where data is available, there was a deterioration in social indicators such as literacy rates, poverty and inequality measures (see e.g. Cornia, Jolly and Stewart, 1987). The question of whether adjustment programmes contributed to this deterioration or alleviated its severity has been the subject of a comprehensive debate, both in and out of academic circles.

This debate has benefitted from contributions of widely different natures, as some examples discussed below will illustrate. Nevertheless, from the viewpoint of economic theory, the complexity of the various mechanisms through which different policies can impact on incomes and living standards suggests that a general equilibrium model, tracing the joint effects of all policies combined on the incomes received by the chosen recipient units would be appropriate. Such an approach was indeed adopted by Bourguignon, de Melo and Suwa (1991), who based their analysis on a Computable General Equilibrium

(CGE) model and generated a number of interesting insights, some of which are discussed in this introduction.

Illuminating though they may be, however, CGE models have their shortcomings. The importance of parametric and functional form assumptions is not always transparent. In the study of income distribution, the level of disaggregation of income recipients is likely to be an issue. Dynamics are not easily incorporated, particularly long term intertemporally optimizing behaviour.[1] Not all of the issues concerning the distributions of income and wealth in the context of economic reform could possibly have been solved by a CGE approach. In particular, there appears to be scope for further analysis of the long term dynamic implications of policy changes, as well as a continuing need for detailed empirical investigation of specific case studies.

This thesis is a collection of essays on the interplay between policies associated with structural adjustment and changes in the distributions of income and wealth. It seeks to contribute to the debate by focusing on exactly those two areas mentioned above: policy effects on the long-run, steady-state dynamics of the income distribution, on the theoretical side; and on the empirical side, a thorough investigation of inequality and poverty trends during a turbulent period of attempts at stabilization in a particular country. In particular, the chapters that follow consider the long-term implications of a key component of the policy package, namely expenditure reduction, and analyze new evidence from a large household survey data set for Brazil.

The remainder of this introduction is structured as follows. Section 2 defines some basic concepts and briefly surveys the causes of adjustment. Section 3 provides a stylized discussion of the nature of the process, based on a diagram due to Bourguignon, de Melo and Morrisson (1991), and lists the key policies that constitute a stabilization and adjustment package. Section 4 reports on the rising concern with their effects on the distribution of income and assets, i.e. on equity issues, and suggests five separate channels through which these effects take place. Section 5 contains a summary outline of the rest of the thesis.

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[1] See Stern (1989, pp 647-648) for a critical assessment of these models.

2) The Causes of Adjustment.

The prominence of the terms stabilization and adjustment is less than two decades old and, possibly as a result, their usage has been fairly loose. In the early 1980s they were used somewhat interchangeably and the World Development Reports (WDRs) 1980 and 1981 used adjustment to refer to the responses of the international financial system to the balance of payments disequilibria set in motion by the two oil price shocks of 1973/74 and 1979/80. This involved recommendations for all countries facing increased current account deficits to shift resources to the production of tradeables (either exports or import substitutes), but it equally encompassed capital flows from the current account surplus countries (essentially the oil exporters) to those in deficit. The emphasis was on the macro variables, specifically the balance of payments, and on international rather than internal aspects.

At the same time, there was a dominant view amongst academics (see e.g. Dornbusch, 1982) that balance of payments problems were often to be found alongside high inflation and that they had a common cause in large fiscal deficits. The programmes aimed to tackle these, also involving real exchange rate depreciations and hence the transfer of productive resources from the nontradeables to the tradeables sector, were referred to as stabilization programmes. Some then suggested that what needed stabilization was the price level, so that this term was to be understood as fighting inflation, while macroeconomic adjustment was a combined attempt at restoring both internal and external equilibria, i.e. some acceptable, low inflation "full employment" rate of unemployment, alongside an approximately balanced current account.

The view soon emerged, however, that to achieve such macroeconomic targets a great amount of change was necessary, at a micro level, in the structures of the economy. Adjustment had to focus, it was suggested, on property rights, the boundaries between private and public sector economic activity, trade policy, institutional efficiency, development of financial systems, management practices, and so on. This comprehensive reform of economic activity was termed "structural adjustment" and stabilization was then to be understood as the complementary efforts to achieve broad macroeconomic equilibrium through the normal macro policy instruments. This point was made explicitly in the WDR 1986 (p.40). Even more recently, it was suggested that stabilization policies

deal mainly with the demand side, whereas adjustment refers to reforms in the supply side. (WDR 1991, p.113)

Throughout this thesis I adopt the definitions which became consensual in the mid-1980s, namely that stabilization policies are those which aim to achieve broad macroeconomic equilibrium, i.e. to reduce inflation to acceptable levels, raise employment to levels compatible with non-accelerating inflation, and reduce current account deficits, by affecting the level and composition of aggregate demand. The term corresponds to the expression "macroeconomic adjustment", common in the earlier literature. Structural adjustment, on the other hand, aims to increase the efficiency with which agents perform their roles and allocate their resources, and thus has more of a supply-side focus. To use the textbook concepts, if stabilization tries to move the economy to the intersection of goods, labour and assets markets equilibria, as well as Balance of Payments, adjustment aims to move the economy from within the production possibility set to its boundary. In the following section I discuss in more detail the policies employed in each area, whereas I now turn to an account of how the disequilibria which required rectifying came to be so widespread in the early 1980s.

The experience of stabilization and adjustment can not be understood without reference to the oil price shocks of the 1970s, the period of international 'recycling' of funds that they set in motion, and the subsequent debt crisis. The oil shocks had a strong stagflationary impact on the world economy (see Bruno and Sachs, 1985), and Table 1 traces the evolution of oil prices, alongside growth rates and current account surpluses for three categories of countries during the 1970s. Industrial countries grew at 4.5% per capita per annum on average between 1960 and 1970, but only 2.5% between 1970 and 1980. Developing countries per capita growth declined from 3.5% to 2.7% in the same period (WDR 1981, p.3). In addition, given the importance of oil in international trade, its price rise also caused significant changes in global terms of trade, giving rise to very large payments imbalances.

These imbalances lasted for a substantial period, because many non-oil exporting developing countries responded to the shocks differently from their industrial counterparts. Table 1 illustrates that whilst the latter tended to reduce their growth rates more sharply in response to dearer oil (and the subsequent inward shift of the factor price frontier),

Table 1:

The Responses of Developed and Developing Countries to the Oil Shocks of the 1970s

	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Oil Prices[a]	2.70	9.76	10.72	11.51	12.40	12.70	16.97	28.67	32.57	33.49
Industrial Countries										
- Growth Rate[c]	5.59	0.02	-1.07	4.40	3.42	5.52	2.51	0.97	1.49	-1.19
- Current Account Surplus[b]	20	-11	20	1	-2	33	-6	-40	1	-1
Oil Exporting Developing Countries										
- Growth Rate[c]	6.39	5.34	-1.29	5.93	1.50	-3.56	3.96	-4.66	-4.59	1.63
- Current Account Surplus[b]	7	68	35	40	30	2	69	114	65	-2
Other Developing Countries										
- Growth Rate[c]	4.34	3.75	2.85	3.22	4.02	3.09	2.16	3.31	1.54	-2.11
- Current Account Surplus[b]	-11	-37	-46	-31	-29	-41	-61	-89	-108	-87

Notes: [a]US$/barrel, for Saudi Arabian crude at Ras Tanura;
[b]US$ billion, in the IMF (1983) definitions;
[c] Weighted average growth rate of real GDP per capita (RGDP, Summers and Heston, 1988), with weights given by RGDPs as a share of group's RGDP.

Sources: IMF International Financial Statistics (Yearbook, 1981; December 1985)
IMF Balance of Payments Statistics Yearbook, 1983, Vol.34.
Summers and Heston (1988).

restoring their current accounts to balance - or indeed surplus - relatively rapidly, the former registered a much less pronounced fall in growth rates in the immediate aftermath of a shock, but allowed their current account deficits to grow almost tenfold, on average, from 1973 to 1981. This was made possible by the availability of funds in the international financial system to finance those large and growing deficits. The funds originated from the large current account surpluses being run by the oil exporters and, although there was some increase in concessional flows, it was channelled predominantly through the Western commercial banking system.

These loans, often made at negative real interest rates, provided for the so-called 'recycling' of funds which was seen by many policy makers, in the developing world as well as in the World Bank and many commercial banks, as a perfectly rational and appropriate response to the shocks, in that it enabled a much smaller reduction in domestic absorption, effectively cushioning countries from the need to adjust to sharply lower terms of trade. A smaller cut in absorption was supposed to allow for investment aimed at shifting productive resources to the tradeables sector, while avoiding the slowdown in growth and decline in living standards which would have been inevitable if such reforms were to have taken place in the absence of any external financing. For the commercial banks, this was seen as a safe portfolio option, following the credo of CITICORP Chairman Walter Wriston, who stated that "countries never go bankrupt" (see Sachs, 1989).

A combination of abrupt changes in the external situation at the turn of the decade conspired to drastically alter that perception. After the second oil shock in 1979 conditions deteriorated sharply. A weighed index of real (non oil) commodity prices tumbled from 121 in 1977 to 81 in 1982, (1980 = 100), heralding a further significant decline in the terms of trade for most developing countries. The industrial countries responded to the inflationary pressures with an unprecedented tightening of monetary policies, triggered by the accession of Paul Volker to the US Federal Reserve. Combined with the expansionary fiscal policy pursued by the Reagan Administration, this tight monetary policy led real interest rates to rise to historically high levels. The real US prime rate went from -0.6% in 1977 to 12.8% in 1981 (see Dornbusch and Fischer, 1987).

In addition, the subsequent recession in the industrial countries - the sharpest since the

1930s - curtailed demand for imports and triggered protectionist pressures. Developing countries faced the need to expand export earnings at a time when both the unit value of their export basket had declined (the terms of trade effect) and the volume demanded had stopped growing (the volume effect). Table 2 is drawn directly from the World Development Report 1985 [p.56] and contains estimates of the aggregated impacts of these two effects, as well as of the interest rate increase, on selected countries. A comparison of the 1974-75 figures to those of 1979-82 illustrate the greater seriousness of the second oil shock and its combined external effects, vis-a-vis those of the first oil shock.

To make matters worse, both the proportion of developing country debt owed to commercial banks, and that in Variable Interest Rate (VIR) arrangements, had been growing steadily, so that the sharp rise in interest rates increased the debt service burden very rapidly. As a result, combined current account deficits for non oil-exporting developing countries rose from U$40 billion in 1978 to U$115 billion in 1981 (WDR 1983). To keep payments up, borrowing in the thriving international financial markets accelerated even further.

Since demand for exports was so weak, many LDCs had only two ways to deal with these deficits: to sharply lower imports, through economic contraction, or to finance them by borrowing. Most countries chose the latter course, given the political resistance to cuts in the growth rate. Commercial banks, whose exposure to sovereign debt had steadily risen during the seventies, responded by a massive, albeit short-lived, increase in lending. As Jeffrey Sachs puts it: "What is truly remarkable about the bank behaviour is not the lending during 1973-79, but rather the outpouring of new lending during 1980-81, even after the world macroeconomic situation had soured markedly... In a mere two years, 1980 and 1981, total bank exposure nearly doubled over the level of 1979 in the major debtor countries." (Sachs, 1989, p.9).

In August 1982, however, Mexico found it impossible to produce the necessary foreign exchange to make its service payments on time, and the ensuing rescheduling sent shock signals throughout the international financial system. Virtually overnight, voluntary lending to most LDCs all but ceased. The age of concerted lending, aimed only at "rolling over" existing debt, commenced. The huge current account deficits in many LDCs could no longer be financed by foreign capital inflows. Adjustment in the 1980s was to acquire

Table 2
Impact of External Shocks on the Balance of Payments in Selected Developing Countries
(average annual percentage of GDP)

Country	1975-74	1979-80	1981-82
Reschedulers[a]			
Argentina	-0.6	-1.9	-6.4
Brazil	-3.7	-2.8	-8.6
Chile	-4.7	-1.2	-13.3
India	-2.6	-1.6	-4.2
Ivory Coast	0.5	-5.6	-18.9
Jamaica	-9.6	-13.3	-29.4
Mexico	-1.0	-0.2	1.0
Peru	-4.5	-1.5	-5.6
Nigeria	16.7	5.8	3.8
Morocco	0.2	-4.0	-9.7
Philippines	-6.2	-2.4	-10.1
Yugoslavia	-6.7	-2.0	-10.0
Non-reschedulers			
Colombia	-1.4	-3.6	-8.3
Kenya	-8.1	-8.7	-19.0
Egypt	-8.7	-0.8	-1.2
Tunisia	-2.1	2.7	1.9
Korea	-9.5	-8.1	-21.7
Indonesia	12.0	5.6	5.4
Tanzania	-9.3	-6.0	-14.3
Thailand	-3.7	-2.3	-10.1

Note: External shocks are defined as the impact on the balance of payments of (a) changes in the terms of trade; (b) a decline in the growth rate of world demand for a country's exports; and (c) increases in interest rates. Data for 1974-75 show the change from 1971-73; data for 1979-80 and 1981-82 show the change from 1976-78.

[a] Countries that had rescheduled as of the end of 1984.

Source: World Development Report 1985, p.56.

a new face. It was no longer a concerted global effort at responding to terms of trade changes that had originated in the oil price shocks, and recycling the resulting surpluses across the international economy, for which borrowing was seen as a legitimate instrument. The causation now ran from debt - and the 'Debt Crisis' - rather than oil prices, to adjustment, and the latter was to be seen fundamentally as an internal, country specific process.[2]

3) The Nature of Adjustment.

With recourse to foreign finance sharply curtailed for most debtors, countries had no choice but to bring expenditure in line with income. Figure 1, adapted from Figure 2 in Bourguignon, de Melo and Morrisson (1991, p.1489), captures the essence of the shock, and the necessary stabilization response. Let there be two economies, F (for flexible) and R (for rigid), both of which produce a tradeable good T and a non-tradeable good N. They have identical tastes, endowments and technologies, but different degrees of price rigidity. Their tastes are represented by an income-consumption curve (ICC), which maps the locus of tangencies between all isocost lines (for a fixed relative price) and indifference curves. I.e. there is one ICC for each relative price. Endowments and technology are represented by the (common) production possibility set. Now let each economy initially receive an identical foreign income transfer (measured in terms of tradeables: $FC_F^0 = RC_R^0$). We can model an external shock straight-forwardly as the suspension of that transfer, which previously allowed both economies to consume in excess of their production. It can be interpreted as a cessation of foreign lending, or an increase in interest rates leading to much larger debt service outlays. F is an efficient economy with no price rigidities, and R is an economy whose policies and institutions lead to significant X-inefficiencies, and which thus produces at R, inside its PPF. This distinction is useful to highlight the role of structural adjustment, vis-a-vis that of stabilization. I return to this distinction below.

As the transfer stops (i.e. the current account deficit can no longer be financed), both countries are faced with the need to reduce expenditure in order to bring it into line with the income actually available to them. Furthermore, at ruling prices, there would be an

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[2] A brief survey comparing academic work on both the causes and possible solutions to the debt crisis with views expressed by the World Bank is included in Chapter 2.

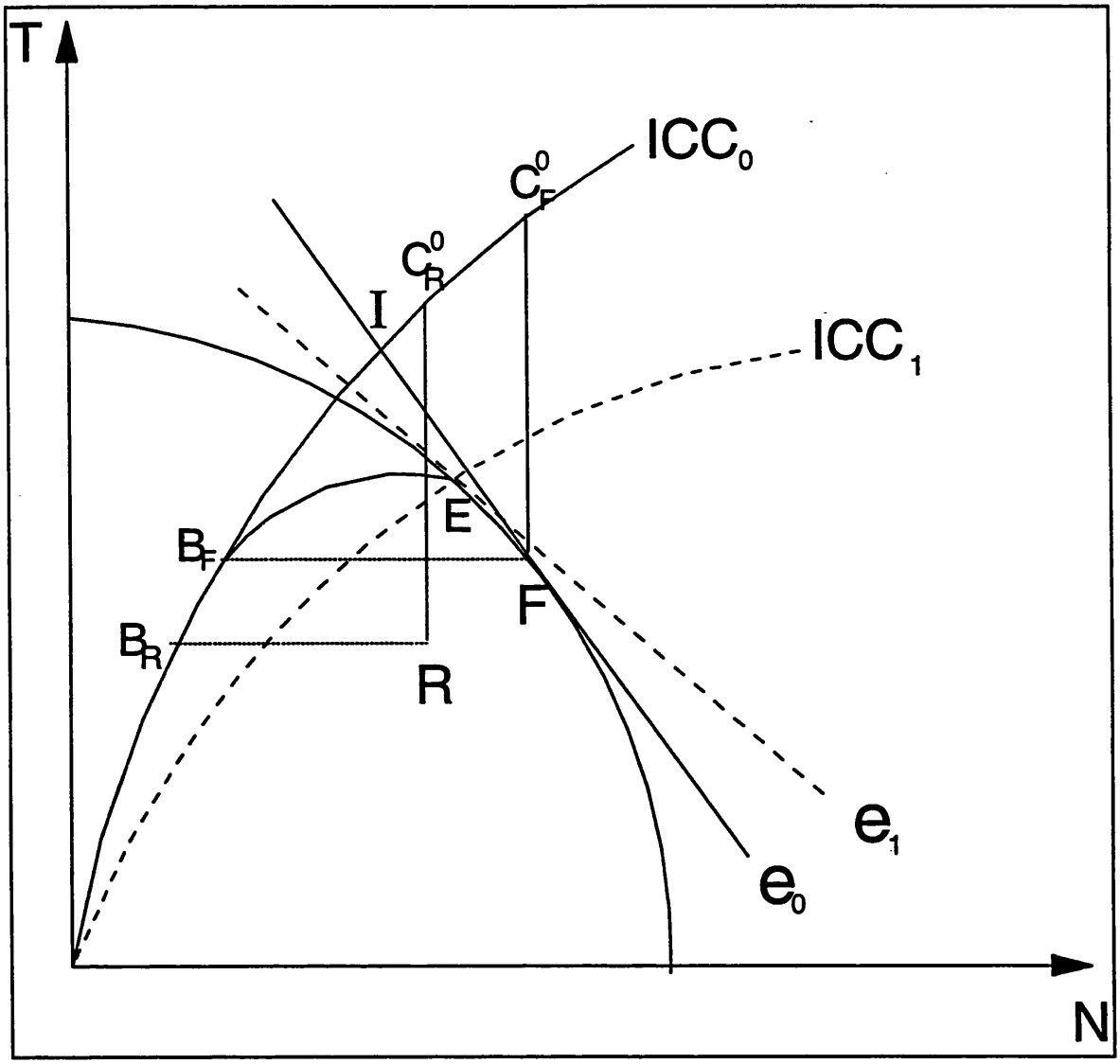

Figure 1: Flexible and rigid responses to an external shock.

excess demand (supply) for tradeables (non-tradeables), as F would wish to consume at I, which is not feasible. If prices adjust fully flexibly, ICC_0 shifts to ICC_1, as the real exchange rate depreciates to e_1, and the economy reaches equilibrium at E. The cost of the shock then, if there are no rigidities and prices adjust costlessly and immediately, is the value of the transfer that is lost to the economy. But there are no secondary costs, no costs of the adjustment process itself.

This is not the case if rigidities exist in the goods, assets or factor markets. In the simplified framework of Figure 1, this is represented by a rigid real exchange rate. If e stays fixed at e_0, consumption must take place somewhere along ICC_0. But the external constraint must now be met out of the country's own resources. If a devaluation is

precluded by rigidities, income must come down further to lower imports. Given the prices implied by the slope of e_0, production would take place at F, and consumption at I. In the absence of a capital account surplus, this is infeasible. If e_0 will not adjust - which is how the authors proxy for rigidities in the economy, and which derives empirical relevance from the large number of adjusting countries maintaining overvalued currencies - income must be brought further down. In other words, if expenditure switching won't occur, expenditure reduction must be even greater than would have otherwise been the case. This happens through a contraction of the sector for whose output there is excess supply, N. The factors thereby released remain unemployed, as price signals do not induce producers in the tradeable sector to expand. This corresponds to a horizontal leftward movement from F. External equilibrium is reached at B_F. If there is partial relative price adjustment, the economy will end up somewhere along line B_FE. Some costs of adjustment, measured in terms of lower or negative income per capita growth rates, reductions in the investment/GNP ratio, etc, can be captured by this move inwards in the production possibility set. They depend crucially on the existence of rigidities and market imperfections that preclude an immediate adjustment.

For the inefficient economy R, apart from stabilization policies similar to those used by F, such as a real devaluation and expenditure reduction, structural reforms are necessary to improve X-efficiency. These policies, which are described below, come under the guise of structural adjustment, and are designed to improve resource allocation and use in a distorted economy. If R is successful in removing these distortions, and allows relative prices (here proxied solely by the real exchange rate) to adjust smoothly to reflect relative scarcities, it too could resume equilibrium at E. Otherwise, it will be somewhere between B_R and E.

This picture and the story it tells suggest a schematic understanding of the processes of stabilization and structural adjustment, and of the differences and complementarities between them. Stabilization policies aim "to achieve sustainable fiscal and balance of payments current account deficits and to reduce the rate of inflation".[3] They generally involve two components: expenditure reduction, usually through contractionary fiscal or monetary policies, and expenditure switching, through policies aimed at producing a

[3] World Bank (1990c, p.8), as cited in Thomas (1992).

devaluation of the real exchange rate. These policies are macroeconomic in nature, and focus on the demand side.

Structural adjustment, on the other hand, has come to be seen as encompassing a large range of policy reforms - macroeconomic, microeconomic and sectoral in nature - aimed at improving resource allocation and increasing economic efficiency. They are concerned with the performance of the supply-side of the economy, and include:

- trade reform, whereby systems of protection are reformed to bring about equal incentives to produce for sale in the domestic and foreign markets, by bringing prices closer to their shadow values;
- price reform, related principally to rationalizing public sector pricing;
- tax reform, aimed both at increasing the efficiency (and equity?) of revenue raising, as well as often raising revenue itself;
- financial liberalization, aimed at improving the functioning and completeness of domestic capital markets;
- privatization, aimed at redrawing the borders between the public and private sectors in accordance with new views as to their comparative advantages;
- labour market reforms, aimed at increasing flexibility and integration in and among these markets;
- institution building, aimed to increase the administrative capacity of government.[4]

Naturally, there is a great deal of interaction between stabilization policies and structural adjustment reforms. There is a growing literature on complementarities, conflicts, and timing and sequencing issues between them, but they are not our main concern here. It is also true that, although I have presented a schematic list of policies, adjustment packages must be devised with careful consideration to the conditions of each specific economy, including different structural and sectoral make-ups as well as different parameter values in any underlying models. Our main concern, however, is with the impact that different stabilization and adjustment policies have on the distribution of income and assets in an economy. By affecting those distributions, the policies will inevitably impact upon poverty and inequality indicators, as well as on the future asset accumulation path for different agents. Below, I look briefly at the current state of the

[4] Each of these seven headings is discussed in more detail in Chapter 2-5.

literature on equity effects of adjustment.

4) Adjustment and Equity.

The change in the value of the effective exchange rate, increasing the price of tradeable goods relative to that of non-tradeables, the reduction in aggregate demand as a result of expenditure reduction, and the system-wide reforms implemented under structural adjustment must - and indeed some are explicitly designed to - affect the rewards to factors in different sectors and activities in the economy. Government expenditure cuts, and changes in its overall composition, must also affect secondary incomes (e.g. transfers) and entitlements. In the presence of any price rigidities - as suggested in the preceding section - the expenditure reduction policies can also affect the level of employment, both formal and informal. These and other effects virtually guarantee that income distribution is affected by structural adjustment.

Nevertheless, when these programmes were first designed, say under Structural Adjustment Lending (SAL) by the World Bank, which was launched in 1980, little attention was paid to distributional impacts. The view was that, provided external finance was available to soften the expenditure reduction and spread it over time, adjustment could be expected to reduce poverty over the medium to long-term. This was because it intended to remove distortions that impeded faster growth, and because there was a general perception that poor people produced mostly tradeables (as in agriculture), and would hence benefit from an increase in their relative prices.[5]

Concern with negative distributional impacts grew as evidence from countries undergoing adjustment became more plentiful. The works of Addison and Demery (1985), Cornia, Jolly and Stewart (1987) and Demery and Addison (1987) contributed greatly to raising the profile of distributional issues in connection with adjustment programmes in the academic sphere.[6] After Adjustment with a Human Face (by Cornia et al, 1987), in

[5] Noteworthy exceptions to this cavalier attitude are to be found in Johnson and Salop (1980) and in McNamara's speech to the Board of the World Bank in September 1980 (see McNamara, 1981).

[6] It has to be said that among political parties in adjusting countries, the debate had been raging for some time by the mid-1980s.

particular, there was a considerable increase in the attention paid to these issues. Heller et al (1988), Cornia and Stewart (1990), Kanbur (1990) and others have focused on them.[7] A number of channels through which stabilization and adjustment policies impact upon the distribution of welfare may be identified from a reading of this literature. Below, I list five interrelated - but conceptually distinct - types of effects:

I) Relative price effects: The following policies are likely directly or indirectly to alter relative goods and services prices, thus changing consumption patterns, incentives for production and real incomes: changes in the real exchange rate (normally devaluations); trade reforms, by abolishing quotas, lowering tariffs, creating or altering export subsidies and so on; price reforms, by raising public sector prices and often farmgate prices paid to agricultural producers; and tax reforms, in particular by redesigning subsidies and indirect taxes. For the moment we do not consider factor prices. These are also likely to be affected, and are clearly of great importance, but are best considered under other headings below.

II) Labour Market Effects: These are impacts upon a crucial set of factor prices, the wage rates in different sectors or for different types of labour (i.e, formal or informal, skilled or unskilled), as well as any effects on the level of employment itself. The evidence on unemployment and informal sector employment during adjustment is sufficiently strong to warrant abandoning the extreme assumption that there are no nominal rigidities, and it may be useful to allow for models where the labour market (or at least its formal segment) does not clear at all times.[8] The policies which affect it most directly are expenditure reduction, in all its varieties, by affecting the level of activity and the demand for labour. However, if factor mobility is not perfect, or if price rigidities exist, as shown in figure 1, expenditure switching policies will also affect employment levels and/or wage rates. From the supply-side, privatization and labour market reforms are also obviously likely to affect wages and employment.

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[7] Chapter 2-6 examines this literature in greater detail.

[8] Blejer and Guerrero (1990) found that in the Philippines, for example, "...macroeconomic adjustment negatively affected the poorer sectors mainly through the increase in underemployment that followed the stabilization programme." (p. 418).

III) Asset Prices and Capital Gains and Losses: Bourguignon, Branson and de Melo (1991) noted that an important channel for impact of structural adjustment upon the distribution of wealth is through changes in asset prices. Portfolio shifts in response to expected asset price changes can generate capital gains and losses which redistribute wealth. The authors suggest shifts toward foreign currency denominated assets (e.g. capital flight) as one example. Another is the differentiated ability to hedge against inflation. If there are barriers to enter the markets for some interest bearing assets, so that the poor have less ability to protect their wealth against the inflation tax, inflation will have a strong redistributive impact. That becomes important when choosing between different adjustment packages that yield different rates of inflation (see table 4, p.24, in Bourguignon, Branson and de Melo, 1991). The evidence for Brazil presented in Chapters 6, 7 and 8 underscores the importance of this effect.

IV) Public Expenditure Effects on Entitlements: Expenditure reduction policies have microeconomic effects, as well as contractionary macro consequences. Governments do not normally cut all elements of their expenditure equiproportionately, and different programmes benefit different groups or classes. Hence, cuts in food subsidies or basic health care are likely to affect the poor more heavily than the rich. The difference between the former and the latter, when public health care is provided free of charge and seen as a highly inferior good, is that the cut in subsidies is captured as a price effect, under (I) above. But the latter, although it will surely affect welfare, by increasing queues, lowering the standard of service and, indeed, its value to the consumer, will not be captured by price changes.

This is one example of a broader category of "entitlements", the value of which can not be captured by conventional income measures. This is not to say that they could not be 'priced'. It is simply to say that some expenditure cuts, particularly in the areas of education, health services and infrastructure (irrigation schemes, rural roads, etc), affect the level and distribution of welfare in ways which are not captured by the conventional budget constraint, in terms of prices or income changes.[9] Much of the emphasis on the effects of public expenditure cuts on the welfare of the poor, such as in Cornia and

[9] This observation draws on A.K. Sen's so-called "entitlement approach", which is discussed, inter alia, in Sen (1981).

Stewart (1990), is of this type, and has to be estimated or measured beyond the effects of relative price changes, asset price changes, or labour market effects. Nevertheless, there has so far been no attempt to model these effects formally, as far as I am aware.

V) Long Term Effects on the Accumulation of Capital: Many authors have noted that the decline in the Investment/GNP ratio during adjustment may have detrimental effects on the intertemporal distribution of income, by lowering the growth rate. Evidence on the effect of a 'pause' in investment on long term growth trends is scarce, partly because adjustment is still a relatively recent experience. But another long term impact is that on the future (intra-temporal, cross-section) distributions of income and assets, as a result of different rates of capital accumulation, both physical and human. It is now widely accepted that human capital, or skills, should be seen as an important input and determinant of growth (see Lucas, 1988). There is also evidence of declines in government expenditures on health and education during adjustment, with a measurable impact on enrolment rates and health standards.

If, as suggested above, publicly provided health and education services are inferior goods, then these cuts are likely to be affecting the rates of human capital accumulation among the poor especially severely. Similarly, if capital market imperfections preclude the access of the poor to some assets, then the rates of physical capital accumulation will also differ. This is an effect separate from that on their current welfare, under (IV), as it will lower their future wealth and the return on their human assets in the future. If the poor are more affected than other social groups, this may have an inequality augmenting effect over time. The models presented in Chapters 3, 4 and 5 are designed to explore a possible setting in which the combination of effects (IV) and (V) above may lead to both a reduction in the economy's overall growth rate and to an increase in income, wealth and consumption dispersion within the society.

5) A Plan of the Thesis.

Two things should be clear from this introductory discussion. The first is that structural adjustment is a name used to describe a complex set of policies aimed at system-wide economic reform. While it may have arisen in response to specific historical circumstances, affecting many countries, its theoretical study is in principle as complex

as the study of economic transformation anywhere else. Policies and impacts that are system-wide require analysis from many branches and through many approaches in economics. The second thing is that an analysis of its impacts on the distributions of income and wealth poses particularly complex issues, due both to the systemic nature of the reform and to the level of data disaggregation that its empirical study requires.

It follows from these two observations that no single thesis or volume could do justice to the whole theme of the distributional effects of structural adjustment. This introductory chapter has provided brief general discussions of the causes and nature of the reforms known as structural adjustment, and suggested five conceptual channels through which they impact on individual or household incomes across any country's distribution. The remainder of the thesis must narrow the focus, and will concentrate on two aspects: a theoretical analysis of the two last channels discussed above - namely public expenditure effects on entitlements and the long term effects on the accumulation of capital - and the application of best-practice distributional analysis techniques to an actual household level data-set, where some impacts of economic reform can be identified.

The thesis is divided in three parts. An institutional chapter surveys the evolution of the World Bank's views on international debt and adjustment during the 1980s, often comparing it to ideas being generated elsewhere. The twin objectives are to gain insight into the thought processes of an institution so important in urging the process forward in many countries, and to simultaneously review the main arguments relating to the policies whose impacts we turn to next. A theoretical part considers the long term implications for income distribution of the post-adjustment permanent reduction in the role of the state in the public provision of some important inputs, such as health care, education and infrastructure. This part focuses on channels (IV) and (V) in the above list, which have been comparatively understudied in the literature. The modelling techniques employed, which are not commonly associated with the study of structural adjustment, are suitable for the long-run dynamic issues involved and, in my view, add powerful insights to the subject under study. Finally, the empirical part describes the evolution of the distribution of income - and of some poverty indicators - in Brazil during the 1980s. Below, I provide a brief summary of each of the seven remaining chapters.

Chapter 2 provides an insight into the evolution of thinking on the causes of and solutions

to the international debt crisis, which in so many cases triggered the need for adjustment, and on the process of structural adjustment itself, within one of the most influential international institutions involved in the process. Careful surveying of World Bank publications, such as the World Development Reports, the World Debt Tables, Operations Evaluation Department reports, working papers, etc, reveals that views changed considerably during the decade. A comparative assessment is also made, with reference to leading work being published concurrently elsewhere. Although an understanding of the intellectual dynamics regarding adjustment in an institution such as the World Bank is the principal objective of the chapter, it is hoped that the survey complements the discussion of the policies and their impacts on welfare and the distribution of income contained in this introduction.

Chapters 3, 4 and 5 constitute the theoretical part of the thesis. It is concerned with one of the basic pillars of the adjustment package: the need for expenditure reduction. Whilst in the short run this may be seen as a temporary policy of demand management, the predominant view in structural adjustment packages has been that a contraction in the role of the government in the economy in the long run was also desirable. But if many services provided free-of-charge by the public sector can easily be replaced by private alternatives by richer people, this may not be so easy for the poor. In particular, if the services can be seen as productive inputs, a reduction in their supply may bring about a permanent increase in inequality of opportunity.

Chapter 3 addresses this issue by proposing a model of wealth distribution dynamics with a capital market imperfection and a production function where public capital is complementary to private capital. A unique invariant steady-state distribution is derived, with three social classes: subsistence workers, 'government-dependent' middle-class entrepreneurs and 'private-infrastructure-owning' upper-class entrepreneurs. It is shown that there is a minimum level of public investment below which the middle class disappears, and that increases in non-targeted public investment over some range lead to unambiguously less inequality of opportunity, as well as to greater output. This provides an additional rationale for an active role for the government in infrastructure, health and education provision, and has implications for foreign aid.

Chapter 4 explores some of the determinants of the optimal income tax rate in a model

such as that presented in chapter 3. There is a brief conceptual discussion of wider policy options, with both tax and expenditure as more general functions of household wealth levels, and for varying government objectives. But the formal treatment is restricted to the case of non-targeted expenditures and a proportional income tax, as assumed in the previous chapter. The optimal tax is shown to depend on a number of factors, including the limiting wealth distribution. Conditions are derived for the optimal tax rate to be positive, and some of its properties are discussed. The chapter both provides support for some of the assumptions underlying the analysis in chapter 3, and suggests a number of questions for future research.

Chapter 5 extends the analysis of chapter 3 to a framework compatible with positive steady-state per-capita income growth. It uses a model of the endogenous growth variety, but the focus is on the duality of the economy: one group with access to a private technology that can be used to replace public investment, and one without. These groups were derived endogenously in chapter 3, and here their intertemporally optimizing behaviour leads to ever-increasing divergence, if public investment falls below a certain threshold. Different modelling techniques capture a flavour similar to that of the previous chapter, but interesting differences arise with a more satisfactory characterization of the choice of intertemporal consumption path. The role of public infrastructure, health and education spending as a 'social cement' comes starkly out of the model.

Chapters 6, 7 and 8 constitute the empirical part of the thesis. Chapter 6 provides a brief account of the macroeconomic history of Brazil during the 1980s - a decade characterized by high inflation, stagnation and instability - as a background to the changes in income distribution that are reported in the subsequent chapters.

Chapter 7 begins with a brief survey of the basic concepts and techniques used in the distributional analysis that follows. It also describes the PNAD data set, an annual repeated cross-section household survey from 1981 to 1990. Summary statistics, decile means and decile shares are then presented for every year, as well as scalar inequality and poverty measures. But the focus of the chapter is on welfare and inequality ordering. First and second order stochastic dominance results are reported for a number of distributions at the percentile level of aggregation, and statistical tests are performed to infer population dominance. Sensitivity of the trends to the equivalence scale used is investigated. Poverty

mixed dominance results are also presented, for a range of plausible poverty lines. The basic finding is that inequality worsened during the 1980s, although not monotonically. Poverty also grew, despite some growth in the mean of reported incomes, but its behaviour was more cyclical than that of inequality.

Chapter 8 seeks to explain the structure of and the changes in the picture of inequality described in the previous chapter. A standard static decomposition technique is applied to three members of the Generalised Entropy class of inequality measures for Brazil, to account for the role played by geographic location, age, gender, race and education in explaining levels of inequality at different times in the 1980s. A dynamic decomposition of one of the measures is carried out to apportion total change in inequality to changes in the composition and mean incomes of the various partition groupings. Finally, the chapter investigates the relationships between some macroeconomic variables, such as inflation, and the poverty and inequality measures presented. This is done by means of a set of simple OLS time-series regressions, supported by diagrams and bivariate correlation coefficients.

The thesis is closed by a short concluding chapter, which briefly brings together the main findings reported in the various preceding chapters.

CHAPTER 2

DEBT AND ADJUSTMENT IN THE 1980s: VIEWS FROM THE WORLD BANK[1]

Abstract: This chapter surveys the dominant views of the World Bank on international debt and structural afjustment in the 1980s. Where possible, it sets those views in the context of the wider debate in the economics profession. The analysis is organized around five main themes: the wisdom of large-scale borrowing in the pre-1982 'recycling' period; the search for solutions to the debt crisis after 1982, with particular reference to forgiveness mechanisms; the design of macroeconomic stabilization; the design of microeconomic reforms intended to increase the efficiency of resource allocation and use in adjusting economies; and the monitoring of the effects of these policies and processes on poverty and the distribution of income.

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[1] This chapter brings together in a revised form two previously circulated papers: "The World Bank and the Study of Stabilization and Structural Adjustment in LDCs", circulated as STICERD DEP No.41 in October 1992; and "The World Bank and the Analysis of the International Debt Crisis", written jointly with Beatriz Armendariz de Aghion, circulated as STICERD DEP No.51 in November 1993 and forthcoming as a chapter in J. Harriss, J. Hunter and C. Lewis (eds): The New Institutional Economics and Third World Development, (London: Routledge). Both were produced as part of a project aimed at forming an assessment of the World Bank's intellectual contribution to development economics, for a Brookings volume marking the 50th anniversary of the Bank. The final product was Stern and Ferreira (forthcoming). I am very grateful to Beatriz Armendariz de Aghion, co-author of one of the papers used for this chapter, for permission to use the material in this thesis.

1) Introduction.

This chapter surveys the evolution of the dominant views held at the World Bank concerning the international debt crisis of the 1980s and the subsequent processes of stabilization and structural adjustment. Whenever possible, it takes a comparative perspective by placing the Bank's analysis side by side with views held elsewhere. Because of the centrality of the World Bank to both thinking and policy-making on these issues during the 1980s, the survey is intended to provide further general insight into the nature of adjustment, prior to the more detailed analysis contained in subsequent chapters.

Five main economic themes pervade the survey. The first is the wisdom (or otherwise) of the large capital flows that followed the terms of trade shocks of the 1970s, and which eventually led to a problem of excessive indebtedness for many countries. The second is the search for solutions to the 'debt crisis' that followed and, in particular, the debate on whether a reduction in present value of debts (i.e. forgiveness) was required. The three remaining themes relate to the nature and design of internal reform policies being suggested by the Bank and pursued in a number of countries to adjust to the new international circumstances. The third is the nature of macroeconomic stabilization, of the constraints facing it and of the policies designed to overcome them. The fourth is the evolution of a complex, system-wide array of structural and microeconomic reforms, designed to improve the efficiency of resource allocation in the adjusting economies. The fifth and final theme is the impact of these policies on poverty and inequality.

These themes are approached in this order, section by section, with the discussion within each of them following a roughly chronological order. The first part of the chapter deals with the 'debt crisis'. It focuses on the first two main areas: the macroeconomic management of developing countries in the run up to the debt crisis in the 1970s ('the origins'), and the proposals of mechanisms to address the problem of chronic indebtedness in the 1980s ('the solutions'). It concentrates on the Bank's intellectual contributions to the main issues, and does not address applied operational work with specific countries.

A cautionary note is in order, regarding the complementarity between the Bank and the IMF. It has generally been the case that, whereas the Bank specializes on internal - mostly project or sectoral - microeconomic work, the Fund deals with balance of payments

difficulties and, by implication, with issues of macroeconomic management. In the 1980s, therefore, division of labour between the two institutions might entail the Bank dedicating itself to internal problems of structural adjustment, while the Fund handled the international aspects of managing the debt problem.

Nevertheless, as has been argued elsewhere (see Stern and Ferreira, forthcoming), structural adjustment and stabilization are so closely related to the debt crisis, that an international institution of the size and importance of the World Bank can not afford to rely entirely on others to respond to events and ideas, or indeed to generate those ideas, on debt. There are two major tasks one might reasonably have expected the World Bank to fulfil, in its role as the leading international development agency, with respect to the LDC debt crisis. First, during the run up to the crisis in the 1970s, one would have expected the Bank to have monitored the LDCs' debt build-up and macroeconomic policy as part of its role in country policy assessment. I will argue that more cautious advice on the scale of borrowing in the late 1970s and up to 1982 might have helped avoid - or at least alleviate the severity of -the belated adjustment process that followed in most LDCs.

The second task relates to the period since 1982, when the search for mechanisms to resolve the crisis became crucial to determine how and when growth, poverty alleviation and development in general might resume in a large number of LDCs. The evidence we will discuss suggests that the Bank was overoptimistic before 1982, sometimes disseminating assessments and advice which they would directly contradict later, with the benefit of hindsight. During the crisis, it was slow to come to terms with the need for more imaginative solutions and, indeed, for an element of debt forgiveness. This first part of the chapter is divided into two sections: Section 2 discusses the origins of the crisis and Section 3 looks at proposed solutions.

The second part of the chapter deals with the remaining three main themes, and traces the evolution of the Bank's ideas regarding stabilization and structural adjustment proper, from 1980 to 1990. I will argue that the Bank played a central role in the emergence of structural adjustment as a major issue for developing countries, and that its main contribution was in applying standard microeconomic theory to the design of structural reform packages. Its contributions to the design of macroeconomic stabilization were less substantial, and there were shortcomings in its monitoring of the impact of the policies

it advocated on poverty and income distribution, at least until around 1987.

Naturally, the Bank is not and has never been an intellectual monolith. Dissenting views can probably always be found, and I have concentrated on "dominant" views - i.e. those expressed by senior officers or in publications such as the World Development Reports.[2] While these are not necessarily the 'views of the Board', they do represent the prevalent thoughts of the staff. But even these views were clearly not constant, and changes took place reflecting new evidence, outside pressure or indeed changes in personnel. These changes of opinion are an important part of the story that follows and, as a piece of background information, Table 1 lists some key senior officers of the Bank, from its inception to 1992.

This part of the chapter is divided into three sections. Section 4 examines the Bank's ideas on stabilization; Section 5 looks at the microeconomic issues of allocative efficiency involved in the reforms of the supply side; and Section 6 is concerned with the Bank's attitudes towards the equity implications of adjustment. Section 7 draws some conclusions.

2) Origins of the Debt Crisis.

Historically we have come to mark the onset of the debt crisis in August 1982, when Mexico declared a moratorium on the servicing of its external obligations. But this announcement was only the beginning of a decade of crisis, the causes of which date considerably further back. The medium and short-term process since the oil price shocks was discussed in Chapter 1. A more comprehensive historical discussion is beyond our scope, but see Cuddington and Smith (1985), Dornbusch and Fischer (1987) and Sachs (1989).

Basically, the causes fall into three categories. Long term causes have to do with inappropriate policies in borrowing countries, often in the context of an import substitution development strategy. It has been suggested (e.g. by Berg and Sachs, 1988) that such

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[2] As background information and for reference purposes, a list of themes and key figures associated with all WDRs from 1980 to 1990, as well as a brief comment on each volume, is included in Table A2-1, in the Appendix to Chapter 2.

TABLE 1 : World Bank President and Officers Responsible for Research and Economics

		Senior Research Positions		
Date	**President**	Date	Title	Holder
1946 (June-Dec)	Eugene Meyer	1946-1952	Director, Research Department	Leonard B. Rist
1947-1949	John J. McCloy	1952-1961	Director, Economic Staff	Leonard B. Rist
		1962-1963	Acting Director, Economic Staff	John C. de Wilde
1949-1962	Eugene R. Black	1963-1964	Acting Director, Economic Staff	Dragoslav Avramovic
		1964-1970	Economic Advisor to the President. Chairman, Economic Committee	Irving S. Friedman
1963-1968	George D. Woods	1965-1970	Director, Economics Department	Andrew M. Kamarck
		1970-1972	Economic Advisor to the President. Chairman, Economic Committee	Hollis B. Chenery
1968-1981	Robert S. McNamara	1972-1982	Vice President, Research	Hollis B. Chenery
1982-1987	A. W. Clausen	1982-1987	Vice President, Economics Research Staff	Anne Krueger
1987-1991	Barber Conable		Vice President, Operations Policy Staff	Shahid Hussain
1991-1995	Lewis Preston	1987-1989	Senior Vice President, Policy Research and External Affairs	David Hopper
		1989-1991		Wilfred Thalwitz
		1987-1990	Vice President, Development Economics and Chief Economist	Stanley Fischer
		1991-1992		Lawrence Summers
		1987-1992	Vice President, PRS (now OPS)	Visvanatan Rajagopalan

Sources: Stern with Ferreira (forthcoming).
Mason and Asher (1973): The World Bank since Bretton Woods (Washington, DC: Brookings).
World Bank (1990b): "Setting Research Priorities at the World Bank: An Historical Review", PRE mimeo.

strategies may have considerably lessened a country's ability to service its (foreign currency denominated) debts, by reducing its flexibility to respond to balance of payments crises through a sufficiently rapid export expansion. Medium term causes arise out of the oil shocks of the 1970s, and the short-term causes were provided by the sudden changes in the world macroeconomy in the early 1980s, as discussed in Chapter 1.

The large build-up of external debt in the 1970s did not appear to trouble most academic economists at the time. The consensus, according to Cohen (1993), reflected the view that foreign borrowing by LDCs to finance current account deficits was an equilibrium phenomenon, in the sense that such deficits would allow LDCs to augment productive capacity and repay their debts. Such a view, particularly among development economists, dates back to the two-gap models associated with Chenery and Bruno (1962) and McKinnon (1964). The fixed coefficients that underlie these models implied that developing countries faced two separate constraints to growth: a savings constraint on investment and a foreign exchange constraint on the ability to import (the inputs required for expanding production).

Despite the fact that "two-gap theory fell into disrepute during the later 1960s and 1970s" (Krugman, 1993, p.16), a sense that alleviating the scarcity of foreign exchange would contribute to growth probably lay behind the tacit approval the Bank and most academics gave to the large scale borrowing of the 1970s. In addition, these flows clearly were external savings, which could be used to finance domestic investment. They therefore contributed to relaxing both constraints and, if the investment took place in the tradeables sector, it could be expected to generate returns to repay the debts and lead to growth capable - in time - of compensating for the terms of trade losses of the oil price shocks.

2.1) The Willingness to Pay Approach

Whilst this was perhaps the widespread view in the 1970s, when the absence of headline news kept many in the profession from worrying about sovereign borrowing, there were some notable exceptions. The distinctive feature of international debt contracts is that they cannot be legally enforced. This was highlighted by Eaton and Gersovitz (1981), in a paper which pioneered what later came to be known as the "willingness to pay" approach. It contains a theoretical model and an empirical analysis for the case of sovereign debt

contracted abroad by poor countries. They argue that since such debt cannot be legally enforced, the default penalty from the country's standpoint is the impossibility of re-accessing the international capital markets. They analyze the case where a country derives utility from consumption out of both output and foreign debt, which is assumed to be contracted exclusively for consumption smoothing reasons. Their principal concern is with understanding whether quantities borrowed are determined by demand (in the presence of an upward sloping supply curve for credit) or, given the absence of repayment enforcing, by credit ceilings imposed by the lenders. They are also interested in the comparative statics of changes in the rate of growth or in the income variability on the quantities demanded and credit ceilings.

A key result from their analysis is that: "the probability of default in period t increases monotonically with debt service obligations d(t) in period t." (p.291). Since, in their model:

$$d(t+1) = R\ b(t)$$

it would follow that very sharp increases in the effective interest rate (R), combined with an explosion of new lending (b(t)), such as was observed from 1979 to 1981, should cause the default risk to be increasing quite rapidly.[3]

It also followed from their analysis that lenders would be willing to make risky loans, in a stochastic setting, if interest rates were high enough to induce them to it, so that under uncertainty, default was a possible outcome of the rational actions of optimising agents. Apart from that possibility, they also explicitly allowed for: "misperception by lenders of borrowers' characteristics [which] could lead to default and may, in reality, pose a threat to the stability of the market." (p.299). They also found that both demand for loans and credit ceilings on them increased with the variability of income (denoted by σ)[4]. As σ would be rising as a consequence of the external shocks - other than on the interest rate,

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[3] Eaton and Gersovitz (1981) have one period maturities; b(t) denotes new lending and d(t) denotes repayment obligations at period t.

[4] Under uncertainty, a positive relationship between credit ceilings and the variability of income requires certain parametric restrictions, notably on the discount rate. But they maintain that it is still the likeliest case. It exists unambiguously in the deterministic case. The intuition for it is that a greater variability of income increases the value the debtor places on future access to international capital markets, and hence its willingness to repay the amounts due today.

which enters the framework explicitly - which affected most highly indebted LDCs in the turn of the decade, this would explain a large part of the increase in borrowing after 1979. Whilst this argument accounts for that increase, it also suggests that it would go hand in hand with a significant increase in the risk of system-wide defaults. This is underlined by their empirical analysis, where sixty-five countries in a sample of eighty-one observations appeared more likely to already be supply constrained in their credit from international markets.

This sort of argument might have encouraged a more cautious attitude towards very high levels of borrowing, in the World Bank or elsewhere, prior to the collapse of voluntary lending in 1982. This is not to claim that Eaton and Gersovitz 'predicted' the debt crisis, such as it came to pass. But their paper does provide an interesting benchmark for comparison with the general tone and some specific statements emanating from the Bank around the same time - and later. They will be the subject of the next sub-section.

2.2) The Bank

Between 1974 and 1982, the Bank's view of LDC borrowing was influenced by the need of the global economy to respond to the large current account imbalances which originated with the terms of trade changes of the oil price rise of 1973/4, and were exacerbated by the second shock, in 1979. The Bank's views in this regard did not differ much from those of the majority of academics, who saw the balance of payments disequilibria in LDCs as a natural phenomenon which should translate into an expanded productive capacity in the countries. In particular, while the growth of debt indicators for many countries was noted, borrowing was seen as an essentially beneficial component of the global adjustment process. The domestic dimension of the adjustment process was, in this early phase, seen as secondary to a coordinated international response: "...the world faces the need to adjust - to payments imbalance and expensive energy - on a scale comparable to 1974-75." (WDR 1980, p.3, my emphasis).

The scale of the subsequent adjustment was, of course, much greater than that of 1974-75, but the optimism was partly based on the perception that the large payments imbalances of the late 1970s were something the world had to respond to globally. This was to take place through recycling funds from current account surplus countries to those in deficit.

It would allow adjustment to proceed with relatively little reduction in absorption (as compared to the alternative without borrowing), and thus with a lower cost in terms of 'human development'.[5] It is thus that the WDR 1981 states that: "There is nothing inherently undesirable about external deficits, since deficits implied resource transfer... These effects... provide a rationale for external borrowing to contribute to structural adjustment." (p.54). The WDRs of the day advocated a 'high growth' mode of adjustment; of central importance to this was the availability of external finance to allow a smoothing of import reduction over time and cushion its impact on both consumption and investment.

In his 1975 Presidential Address, McNamara regarded the need of middle-income countries for greater access to external capital as the "...most immediate and pressing problem in the global development scene..." (McNamara, 1981; p.297) In 1977, he felt that "the major lending banks and major borrowing countries are operating on assumptions which are broadly consistent with one another..." He concluded that: "...we are even more confident today than we were a year ago that the debt problem is indeed manageable, and need not stand in the way of desirable rates of growth for the developing countries..." (McNamara, 1981, p.456; see also Gazdar, 1990).

Whilst the second shock in 1979 induced some changes in the Bank's position, these were not sufficient to reverse its 'pro-recycling' emphasis. The most significant change was indeed a greater focus on the need for countries to use external finance to adjust to what was now seen as a permanent change in the world economy, rather than as a substitute for that adjustment: "The point I want to stress here is the necessity of using external finance in support of structural adjustments, and not as a substitute for them." (McNamara's 1980 Address to the Board, in McNamara, 1981, p.620).

The main factors conspiring to make many borrowers' positions unsustainable by 1982 were clearly identified by the WDR (1981): the tightening of monetary conditions globally in 1979, the contemporaneous fall in the terms of trade for most LDCs, the world

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[5] Human development, broadly understood to mean poverty reduction and an improvement in the social indicators and living standards of all - but principally the poorest - segments of developing country populations, was then and had been since McNamara's Nairobi speech in 1973, the paramount articulated policy objective of the Bank.

recession, the rising proportion of debt owed to commercial lenders, the rising proportion of loans contracted in variable interest rate (VIR) agreements, and the rise in commercial bank exposure to LDCs (measured in terms of outstanding loans to LDC customers as share of total portfolio) from 49.6% in 1975 to 61.5% in 1978. In light of the Bank's awareness of these phenomena, it is remarkable that they continued to make the optimistic predictions about the availability of voluntary capital flows in the 1980s which can be seen in Table 2. This table lists predictions for the behaviour of a number of macroeconomic variables during the 1980s, made in the WDR (1981), side by side with the actual realizations. It reveals a picture of consistent overoptimism, which appears to have been strongly related to the assumption that voluntary capital flows would be sustained throughout the decade. In other words, to their failure to foresee the coming of the debt crisis.

So, while the WDR 1981 predicted that middle-income oil-importers would grow by 5%-6% p.a. in the 1980s, their actual average growth between 1980 and 1989 was 2.9% p.a. (WDR 1991). Latin America, which had been expected to grow in the region from 2.3% to 3.2%, had by 1990 averaged negative 0.5% p.a. since 1980. This is clearly not unrelated to the fact that whilst they had predicted net capital transfers to developing countries to have reached US$ 177.9 billion in 1990 (WDR 1980)[6], the World Debt Tables 1991/92 registered a net capital inflow of only US$ 16.0 billion to all developing countries in 1990 (see Table 2). And this followed a period (from 1984 to 1988) of actually negative net transfers.

Their unwillingness to read the signs that they themselves had just laid out, or at least to publicly acknowledge their implications, is made quite plain in the same WDR 1981: "While [the above] trends indicate that the developing countries will face more serious debt-management difficulties in the future, they do not signal a generalized debt problem for the developing countries." (p.61, my emphasis)

The importance of external finance to enable most of these countries to manage the high-growth mode of adjustment advocated in this WDR - and generally by the Bank at this stage - was obvious, so any vestige of doubt as regards its availability was quite

[6] This was revised downwards to US$ 56.7 - 96.0 billion in the WDR (1981).

Table 2

A Comparison of World Bank Predictions[a] and Actual Data for a number of Variables in the 1980s.

	Low Case Prediction	High Case Prediction	Actual Figure
Average Annual % Growth of GNP per capita, 1980-1990 in:			
Industrial Countries	2.3	3.1	2.5
All Developing Countries	2.2	3.3	1.2
Low Income Countries	1.5	2.6	4.1 (1.3)[b]
Middle Income Countries	2.2	3.4	0.5
Latin America and Caribbean	2.3	3.2	-0.5
Oil Exporting Countries [c]	2.9	4.0	-2.5
Average Annual % Growth in Exports for all LDCs, 1980-1990	3.9	7.6	4.1
Official Development Assistance Receipts, 1985[d]	35.5	40.9	25.7
Official Development Assistance Receipts, 1990[d]	53.6	65.7	47.2
Direct Private Investment, 1985[d]	13.6	15.7	4.5
Aggregate Net Transfers, 1985[d,e]	36.3	54.3	-4.6
Aggregate Net Transfers, 1990[d,e]	56.7	96	16.0

Notes:
[a] made in the World Development Report, 1981.
[b] figure in brackets excludes China and India
[c] excludes the USSR
[d] in US$ billions at current prices
[e] defined, as in World Debt Tables, as the difference between aggregate net flows and interest payments on all debt.

Sources: World Development Report, 1981, 1992.
World Debt Tables, 1989/90, 1991/92.

uncomfortable:

> "However, given the profitability of lending to developing countries, their exemplary records (with few exceptions) in meeting their obligations and their continuing need for foreign finance, it seems unlikely that financial intermediaries will discriminate against developing countries as a group."...

Hence:

> "Summing up these various influences on commercial banks, it seems highly probable that both borrowers and lenders will adapt to changing conditions without precipitating any general crisis of confidence." (p.61).

These quotes and predictions reveal an institution publicly unable or unwilling to foresee the impending collapse of voluntary lending, or any of its severe consequences to developing countries, despite the existence of contemporaneous research which pointed to a significant and increasing risk of system-wide default.[7] Admittedly, Eaton and Gersovitz (1981) was an exception to the prevalent view among academics that the amounts of borrowing were appropriate, as noted in section 2.1. Nevertheless, given its unique position in terms both of access to data (on country performances as well as on capital flows) and of its responsibility to provide technical advice and assistance to policy makers in the interests of long-term growth and development, the Bank's endorsement of and emphasis on increased borrowing to facilitate adjustment and create resource transfers, as late as 1981, can not be seen in a very positive light in retrospect.

3) Solutions to the Crisis

The academic debate after 1982 turned to the best ways to remedy the crisis in the LDCs and to prevent the international financial system from collapsing. Agreement on a solution, however, required a consensus about the nature of the problem. The academic profession seemed to be divided in this regard, between those who viewed it as a short-term liquidity problem and those who saw it as a more serious solvency issue.

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[7] It could be argued that other institutions, not least commercial banks and borrowing governments, ought to be singled out for criticism before the Bank. I take no issue with that view. This chapter has chosen to focus on the Bank because of its importance as a provider of development finance and advice to developing countries, and of its original role in the design of structural adjustment programmes.

3.1) The Liquidity versus Solvency Debate and the Rescheduling Strategy

In the first three years (1982-1985), the debate centred on whether LDCs were experiencing a liquidity or a solvency problem. Let TS_t denote the value of a country's trade surplus at time t; $D_{t=0}$ the debt financing obligations due in the current period; r the appropriate discount rate, and j some suitably small integer, representing the market's understanding of the short-run. Denote the expectation operator conditional on information available at time t by E_t. A debtor country was defined as illiquid if the expected present discounted value of its trade surpluses in the short run was not high enough to service its external debt, but when such surpluses in the longer run were. I.e:

$$E_{t=0}\left[\sum_{t=0}^{j}(1+r)^{-t}TS_t\right] < D_{t=0} < E_{t=0}\left[\sum_{t=0}^{\infty}(1+r)^{-t}TS_t\right]$$

Advocates of the liquidity view argued that the crisis was a short-run phenomenon. In particular, Sachs (1984) suggested that the amount borrowed was decided by an LDC government so as to maximize the growth rate, with investment as the control variable. He admitted the possibility that some of the external borrowing did not materialize into higher capital accumulation, particularly because of political reasons, but he did not perceive that as a danger to the ability of LDCs to repay, albeit after some "adjustment period". The policy implications of this view were rather clear: countries should be granted greater access to external financing until they adjusted to the sudden changes in the international macroeconomy. Since their long-term ability to repay was not in question, this was also in the interest of lenders as a group.

Advocates of the solvency view, on the other hand, emphasised that: (a) the debt accumulation of the 1970s came about as a result of LDCs wanting to maintain consumption levels, often at the expense of investment, after a negative terms of trade shock, and (b) the way consumption was being maintained in the short run was through an overvaluation of the real exchange rate (see, in particular, Dornbusch, 1985). Both the framework and the empirical evidence Dornbusch presented suggest the possibility that highly indebted countries were not going to repay their debts, at least not out of the returns on investment, because a large portion of the money borrowed had not been

invested but consumed[8]. Moreover, a large volume of such debt had taken the form of capital flight, as in Argentina and Venezuela[9]. Dornbusch's paper suggested that the whole financial strategy of the 1970s had been a failure and that ways should be found to share the costs, as had been the case in the aftermath of the defaults of the 1930s.[10]

This view was shared by Peter Kenen who, as early as 1983, suggested the creation of an "International Debt Discount Corporation" which would buy the debt from the commercial banks at a 10% discount. It would then be able, because of the discount from which it benefited on purchase, to lower the interest rate charged to debtors and to extend loan maturities.[11]

But those early proposals containing a debt-relief element, although important from a historical viewpoint, were not very influential at the time. The predominant view among academics in the first half of the eighties appears to have had two distinctive features: (a) countries are illiquid, and (b) countries may be unwilling to repay if they are not given the "right incentives". Accordingly, the provision of 'new' lending (or debt rescheduling) was perceived as key to resolving the crisis.

Sachs (1984) modelled the relationship between a debtor country and its foreign creditors

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[8] Dornbusch reports that due to overvalued exchange rates, a large portion of the money borrowed abroad took the form of capital flight in the case of Argentina, consumption of durable imports in the case of Chile, and of large government subsidies to inefficient public sector enterprises in Brazil.

[9] On evidence of capital flight from Latin America in the 1980s, see also Pastor (1990).

[10] Dornbusch often emphasized that in the aftermath of the defaults of the 1930s the creditors had negotiated substantial write downs in the face value of their claims with the LDCs. For more on historical experiences of debt settlements, see Eichengreen and Portes (1989).

[11] Kenen was not the only person to have anticipated in the early eighties the direction the debate would take a few years later. Felix Rohatyn proposed to the US Senate that LDC debt could be stretched out to longer maturities (15 to 30 years) and interest reduced to something like 6%. Norman Bailey, of the US National Security Council, suggested that the debt be swapped for a form of equity asset that would entitle the holder to a fraction of the country's export earnings. (See Cline, 1983, for a more complete survey of these early proposals).

as a Repeated Prisoner's Dilemma in which, as long as both parties sufficiently valued their future relationship, it was in their own interest to play cooperatively[12]. Accordingly, we should expect creditors to be willing to extend new lending to a debtor experiencing financial distress. New lending or, more specifically, the re-lending of the due interest, principal, or both, was in practice seen as the strategy that would prevent widespread defaults and protect the international financial system. The argument for rescheduling became even more forceful in the context of the historical evidence on sovereign defaults. Past defaults, the argument went, could have been avoided if creditors had provided more lending.

The first problem with such a strategy, however, was that there was a multiplicity of creditors involved (see Cline, 1983; Sachs, 1984; and Krugman, 1985 and 1988). In particular, it was argued that the following free-rider, or "moral hazard in team", problem would inevitably arise: because the benefits from new lending are collective, i.e. each individual creditor captures only part of the benefit, it will not be in the interest of a single creditor to extend new loans unless other creditors do so too. Typically, the small (less exposed) banks will be the ones attempting to free-ride on the large ones. To overcome this problem it was thought that a key role as coordinating agencies could be played by international organizations like the Bank and the IMF. In practice, the debt rescheduling strategy gained the support of the US Treasury Secretary in 1985, and thus came to be known as the Baker Plan.

3.2) Debt Overhang and Debt Relief

No sooner did policy makers the world over commit to the Baker Plan than the debate moved on, with a more refined version of the solvency argument. Sachs (1986) and Krugman (1988) noted that some LDCs had accumulated so much debt that some creditors no longer expected to be repaid in full. Hence the high discounts in the secondary market. At such high levels of debt, it was no longer possible for indebted LDCs to obtain voluntary lending. Therefore, they suggested, existing creditors faced the following trade-off (see Krugman, 1988): new lending (or rescheduling) could avert defaults, but would at the same time trigger disincentives to invest in adjustment, as LDCs at such high levels

[12] I.e. the Folk Theorem would hold for a sufficiently high discount factor.

of indebtedness would be discouraged by the awareness that future benefits from investment (or economic adjustment) would accrue largely to their creditors. One way out of this dilemma, Krugman argued, was by forgiving portions of the debt instead. This trade-off is didactically captured in Figure 1.[13]

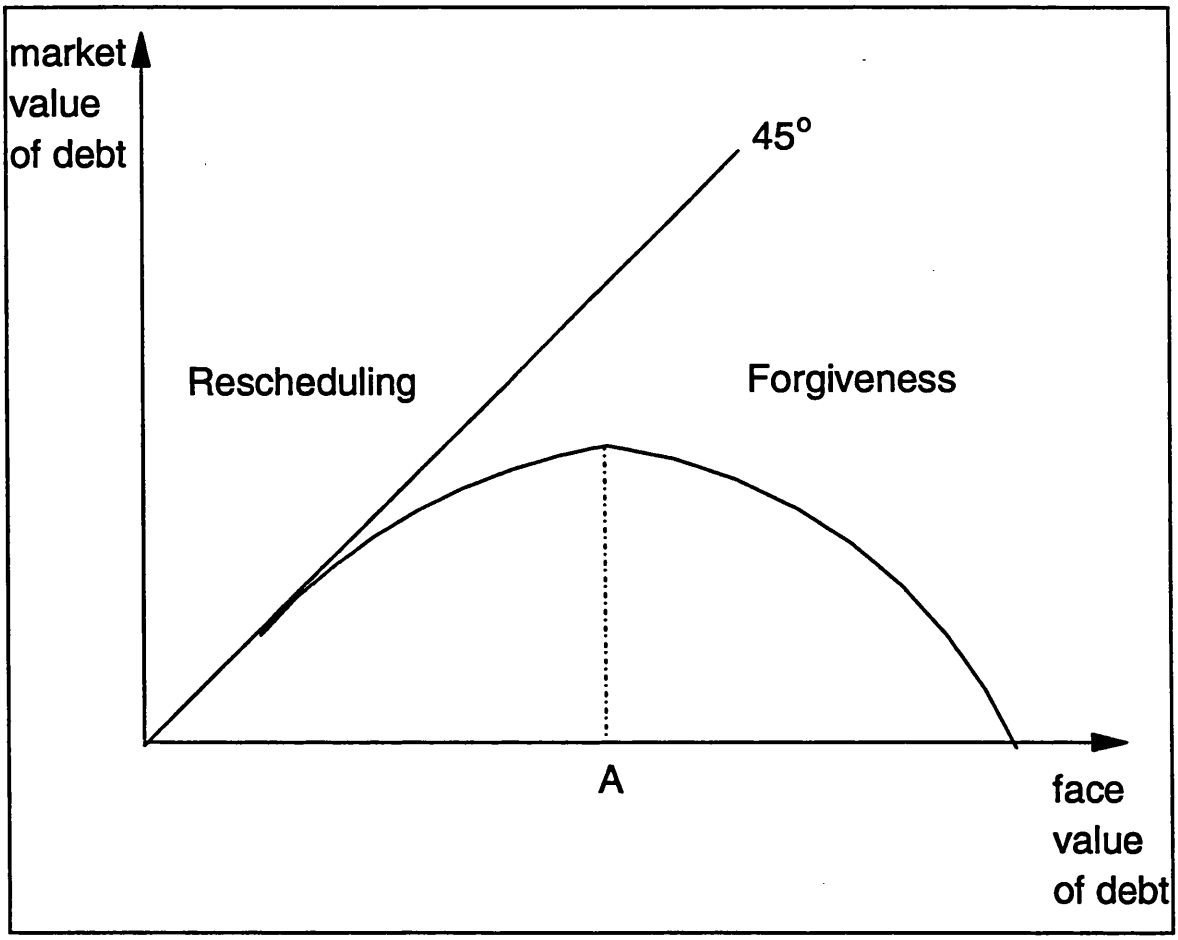

Figure 1: The Debt Relief Laffer Curve

As we move from left to right on the Laffer curve in the above figure, we are first on the 45 degree line. The market value of the debt is then identical to its face value. As the face value of the debt continues growing, say, through rescheduling repayments, the disincentives to invest (or to undertake adjustment policies) come into play. Such disincentive effects will be reflected in the market value of the debt, which will rise less than proportionally to the face value. To the right of point A, the market value of the debt will actually start declining. Creditors may then find it in their interest to forgive portions of their claims.

[13] Figure 1 is drawn from Krugman (1989).

The above incentive argument, known as the debt overhang hypothesis, stands as the most widely accepted rationale for Pareto-improving forgiveness. It gained official support from the US Treasury in March 1989, with the so-called Brady Plan, which called for debt write-downs in the case of heavily indebted middle-income countries. Its counterpart for low income countries was the Toronto agreement[14].

In practice, the adoption of the Brady Plan by the US, and its subsequent acceptance by most other creditor governments, meant that debt reduction became a feasible option, albeit generally in fairly restricted conditions. Due to the large discounts in the secondary market, some LDCs began to engage in a number of transactions involving debt retirement. The simplest of all was straightforward buybacks. However, because debtors were officially banned from undertaking buybacks[15], more sophisticated ways of taking advantage of low market prices for debt were found. Among the most common types of market transactions were debt for equity swaps, debt securization, and debt for nature swaps.[16] Because debt retirement triggers positive incentive effects, these market transactions are generally viewed as a mutually beneficial (i.e. Pareto improving) way out of the crisis. In reality, such transactions have not been substantial.[17]

In sharp contrast with the above framework, Bulow and Rogoff (1988) assume away efficiency gains. In particular, they develop a framework where debt repayments from an LDC to its creditors do not depend on the LDC's economic performance.[18] Then, an exogenous increase in the size of such repayments will benefit the creditors only, by

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[14] The terms of the Toronto Agreement apply to official debt (Paris Club debt), owed by low income, predominantly African, countries. See §3.3 below for more on Toronto.

[15] For both adverse selection and moral hazard reasons: first, they would encourage 'good' debtors to buy themselves out of the market, leaving creditors holding liabilities of 'bad' debtors only and, second, countries might be encouraged to default in order to lower the price of their debt to then undertake the buyback (see Krugman, 1988).

[16] See Armendariz de Aghion (1993).

[17] One exception is Chile, where the debt-for-equity swaps have been large and where their contribution to economic growth and debt repayment has been important (see Armendariz de Aghion, 1991).

[18] In fact, debt repayments are determined ex-ante, in a bargaining model of Bulow and Rogoff (1989).

raising the market price of the debt related assets they hold. One such exogenous increase in the fraction of repayment obligations which is actually met by debtor countries would be brought about by the introduction of foreign aid earmarked for debt retirement. Although the authors illustrate their results for the case of Bolivian debt retirement (or buyback)[19], their analysis can easily be extended to any type of debt relief involving an industrialized country government and/or a multilateral institution like the World Bank. The message, as the authors themselves put it in their concluding remarks, is: "that a well intentioned donor government can help the debtor country more by giving it aid directly than by earmarking the same funds for a buyback" (pp.715).

This framework raised questions regarding the role the World Bank should play in the negotiations for debt relief. Van Wijnbergen (1991) justifies the role of the World Bank in the case of the Mexican debt relief package. He does not deny that some of the benefits from the Bank aid accrued to Mexico's creditors but argues that most of the benefits did accrue to Mexico itself.

3.3) The Bank's Approaches to Solving the Crisis

Having traced the principal ideas in the debate on solutions to the debt crisis since 1982 in §3.1 and §3.2, I now attempt to place the Bank's views and contributions into that context. At the onset of the crisis, the Bank, now under Clausen and Krueger[20], took a very cautious line, changing the focus from the macroeconomic concern with the availability of foreign finance, so prominent under McNamara and Chenery, to microeconomic advice on "getting prices right". External causes were de-emphasized, and the crisis was blamed predominantly on domestic policy errors, notably the use of borrowed funds for consumption or inadequate investment purposes, due to distorted prices. In 1986, an Operations Evaluation Department report stated that: "The flexibility provided by access to foreign borrowing will have been lost because of past policy errors." (World Bank, 1986a).

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[19] Although countries are generally not allowed to buy their debts directly in the secondary market, Bolivia was an exception. In 1987, the Bolivian government was allowed to engage in a buyback experiment carried out with aid from industrialized countries.

[20] As President and Vice-President for the Economics Research Staff, respectively.

The Bank adhered closely to the view, espoused publicly by the governments of its major shareholders, that a 'solution' to the crisis must be based on a 'restoration of creditworthiness', and that the way for countries to achieve this was to maintain debt service up to date and avoid the need for rescheduling loans as long as possible. These objectives could best be secured through prompt efforts at internal adjustment aimed at switching production toward tradeable, through the familiar combination of expenditure-reduction and expenditure-switching policies:

> "Despite the many problems they have had recently, developing countries need a continuing flow of bank lending to regain their growth momentum. For this to happen, however, developing countries must restore their creditworthiness - and that depends on their own policies and on the strength and stability of world economic growth." (WDR 1985, p.124).

The role envisaged for the international financial system was merely to provide some rescheduling when there were no other alternatives. In other words, the Bank adhered firmly to the liquidity view of the debt problem, and gave little serious consideration to the more radical early proposals mentioned above, such as that by Kenen.

This view was qualified, rather than rejected, by conclusions arising from the "International Debt and the Developing Countries" conference, held by the Economics Research Staff of the Bank in April 1984[21]. Participants generally emphasized two shortcomings of the current approach. It was felt that the positive externalities created by involuntary sovereign lending by a private bank and the ensuing free-rider problem provided scope for greater coordination of the process by the IMF, the Bank and even creditor governments. This followed the views expressed by Cline (1983) and Sachs (1984). Second, short-term reschedulings (generally of one year) which were then the rule, were seen as collectively inefficient, even if a single lender had an incentive to keep a problem debtor on a "short leash". A number of authors, and notably Krugman, suggested expanding the scope of rescheduling to provide multi-year restructuring of a country's foreign debt. This again followed from the standard policy implications of the liquidity view in the academic debate, and the suggestion had already been made by, for instance,

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[21] The papers presented at this conference were compiled in a volume edited by Cuddington and Smith (1985), and included contributions by Cooper and Sachs, Gersovitz, Krugman, Simonsen, Dornbusch and Harberger.

Cline (1983).

Although Cuddington and Smith (1985) found that: "...many participants agreed with the notion that some form of debt relief (in effect, forgiveness) may now be necessary." (p.17), the balance of opinion seemed to be that in most countries ultimate ability to generate the necessary stream of foreign exchange - i.e. solvency - existed. In his restructuring proposal, Krugman recognized that *if it were to be seen* as a final settlement of the crisis, "the present value of debt service would have to be written down sharply." (p.97). But he preferred to see it "as a bridge to a future period of normalcy, rather than a way to ramp down countries' debt." (ibid) This allowed him to disregard serious debt forgiveness in his proposed 'guidelines'. In fact, he plainly admitted that "in the current context...it is clear that any debt restructuring will fall well short of reversing the direction of resource transfer [back towards debtors]." (ibid). Gersovitz agrees that, with the exception of special 'problem debtors' - he mentions North Korea, Sudan and Zaire - countries could be expected to service their debts in "a way that preserves their present values" (p.76).

Thus, whilst there were indeed suggestions that some due interest should be capitalized, and the loan maturities extended (Simonsen), as well as that banks ought perhaps to charge interest rates below market rates on some of their loans (Krugman) - justifying the organizers' claim that debt relief was suggested - this was on a very modest scale. This was in contrast to the more radical proposals mentioned earlier, as well as to the tone of the academic debate a few years down the road, and to the views expressed in the Bank's own subsequent conference in 1989.

In terms of policy implementation, there was some response to the concerns expressed at the 1984 conference, both with the short-term nature of rescheduling, and with the need for greater coordination of involuntary lending, to combat the free-rider problem. The Baker Strategy, proposed by the then US Treasury Secretary in March 1985, was intended to address exactly these issues. Longer periods for rescheduling became more common, starting with a $49 billion multi-year package for Mexico. The Conference also appears to have played a catalytic role in disseminating academic ideas to a broader audience, and this is in line with the perception that the Bank was stronger as a communicator than as

a generator of ideas in this area.[22]

But if the Bank's official positions were not radical or innovative in the 1982-1985 period, from 1986 to 1988 they appeared to lag further behind the rapidly evolving debate. In a paper written before joining the Bank, Fischer (1987) emphasizes the severe decline in income per capita in the Baker fifteen heavily indebted countries, the massive resource transfers from these countries and the resulting collapse in their domestic investment rates. The focus had changed substantially from the liquidity view, towards a concern with the seriousness of the effects of the crisis on the debtor countries, and the proposed solutions reflect that change. In this, as well as in most other papers devoted to possible solutions to the crisis in Sachs (1989), the possible desirability of debt relief, and a variety of mechanisms through which to achieve it efficiently are discussed. There is no contention to Sachs's claim - based on the debt overhang argument sketched above - that "partial debt relief can therefore be Pareto improving (i.e. to the benefit of both creditors and debtors)." (p.28). Yet, years after the debt overhang hypothesis had been proposed, the role of the Bank continued to be that of a supporter of the Baker strategy, with its response to the concerns so widely voiced in 1984/5 still based on concerted lending and loan rescheduling.

An indictment of this role appears in the paper by Diwan and Husain (1989)[23] which introduces their volume on Dealing with the Debt Crisis, a report on the Bank's 1989 Conference on Debt. There they acknowledge, in so many words, that the strategy was unsuccessful, that it had modest targets for new money ($13 billion annually), that even those targets were never achieved (net annual flow was only about $4 billion), that "the official sector had only moral suasion to ensure that the private sector met the plan's targets" (p.4) and, fundamentally, that: "controversies, even of a few billion dollars, miss the point: the transfer of resources from the highly indebted countries to the industrial countries for external debt was more than $100 billion during 1986-88." (ibid).

An admission of the reasons behind the Bank's position was given by the Chief Economist

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[22] See Stern and Ferreira (forthcoming).

[23] Both were economists at the Debt and International Finance Division of the International Economics Department of the World Bank.

in 1989:

> "...the record shows that frank and open debate does not take place in official and banking circles. It was clear to the participants in this conference at the beginning of 1989, as it had been clear to many much earlier, that growth in the debtor countries would not return without debt relief. But the official agencies operate on the basis of an agreed upon strategy, and none of them could openly confront the existing strategy without having an alternative to put in place. And to propose such an alternative would have required agreement among the major shareholders of these institutions. So long as the United States was not willing to move, the IFIs were not free to speak..." (S. Fischer, p.v. in Diwan and Husain, 1989).[24]

In 1988, a willingness to contemplate some element of debt reduction began to manifest itself among those "major shareholders". K. Miyazawa, then Japan's finance minister, used the IMF - World Bank meetings in Berlin that year to propose officially sponsored debt reduction schemes. President Mitterrand of France followed suit later that year, in Toronto, where official creditors agreed on a set of guidelines for concessional relief for low-income severely indebted countries, thereafter known as the Toronto terms. The WDR 1988, the first entirely under Fischer as Chief Economist, marks the Bank's official jump from the Baker bandwagon, by including suggestions that some debt relief, and a "reduction of the debt overhang" could be important elements to facilitate the transition from adjustment to growth. It was just in time to claim marginal precedence over the change in the US official position, which came with the Brady Plan in 1989, aimed at middle-income severely indebted countries.

From then on, there appears to have been an increase in the liveliness of the debate on debt in the Bank, as well as in its sponsorship of research on the topic. The Debt and International Finance Department issued papers quite frequently, often focusing on issues connected with voluntary, market-based debt reduction schemes and the related incentive problems (e.g. Claessens, S. (1988): "The Debt Laffer Curve: Some Estimates").

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[24] It is quite likely that the reasons for the Bank's lack of enthusiasm for debt forgiveness were not entirely political. It has been privately suggested by a senior Bank official that, as an intermediary that raises finance from the market, and whose ability to do so is affected by its credit rating, the Bank was naturally hesitant to propose policies which, if applied to its own loans to developing countries, might lead to asset write-offs.

To this improvement in the Bank's record as a follower of the theoretical debate since 1988, it must be added that one sphere of intellectual activity where the Bank had long been making a significant contribution to the study of LDC debt was the publication of comprehensive data on the direction, magnitude and effects of the debt flows. This was mostly through the World Debt Tables which, complemented by the World Development Indicators, provided the basis for much academic and policy work on the subject. Within the framework of the Brady Initiative, furthermore, the Bank's role in helping countries to design and negotiate the menus for debt reduction with their creditors provided new scope for application of the ideas being researched and debated throughout the profession. By the end of 1990, Brady deals had been concluded with Costa Rica, Mexico and the Philippines, and other countries were negotiating their own packages. The Mexican example, besides being the earliest, is also probably the most studied (See van Wijnbergen, 1991; and Armendariz de Aghion and Armendariz de Hinestrosa, 1993). The deal covered some US$49 billion in commercial loans and, according to some estimates, involved US$12 billion of relief. Net external transfers from Mexico were reduced by US$4 billion per year for some six years from 1989. This was accomplished by allowing participating commercial creditors to choose from a menu of facilities including exchange of debt for a discount bond (at 65% of par), or for a par bond with fixed interest at 6.25%, all with 30-year maturities. The Bank and the IMF were involved in financing the required collateral for these bonds, and creditor banks were also given the option to swap debt for equity in a privatization programme.

But the general weakness in the Bank's overall contribution to understanding and resolving the financial flows aspect of the debt crisis must be seen in the context of its leadership in the construction of what came to be the standard LDC domestic response to the crisis. This is the structural adjustment package, to which I turn in the next three sections.

4) Stabilization Policies

The first mention of "adjustment" as a topic in its own right in the Bank's flagship publication, the World Development Report, is to be found in 1980. In February of the same year, the Bank's new Structural Adjustment Lending (SAL) programme was launched, and on 30 September President McNamara chose adjustment as the central subject of his annual address to the Board. Two years prior to the outbreak of the debt

crisis, the Bank was leading development economists into questions about the domestic policy response to the external shocks. The remainder of this chapter describes how its own ideas about stabilization and adjustment evolved over the decade.

The Bank's approach to stabilization in the first three years of the decade was that countries should devalue and reduce fiscal deficits in an orderly fashion. To avoid a collapse of domestic absorption, they should rely on foreign financing to allow for a gradual reduction in current account deficits. This finance should be allocated to productive investment in the tradeable goods sector, thus providing the basis for the "high investment" mode of adjustment they advocated.

This was based on three elements: outward orientation and real exchange rate depreciation; increased savings; and "increas[ing] the share of investment without detriment to its efficiency" (WDR 1981, p.71). The intended purpose of high levels of investment during adjustment was to implement the transfer of resources from the nontradeables to the tradeables sector, just as the purpose of real depreciations was to provide the incentives for private agents to carry it out. This `high investment' mode of adjustment was recommended by the Bank in all WDRs from 1980 to 1982, and was also important in making the necessary changes compatible with McNamara's chief concern, progress - or at least preservation of recent gains - in the sphere of human development.

But the reduction of fiscal deficits and the temporary output deflation resulting from the lags involved in transferring resources across sectors of the economy could only have been compatible with higher investment and the maintenance of minimum levels of consumption for the majority of the population if substantial capital inflows had continued to be available to finance adjustment: "If the necessary finance could not be obtained - because of concern about creditworthiness, for example - growth could slip even lower than the Low Case, and the number of countries in serious debt difficulties would increase." (WDR 1980, p.10). As we know from Table 2 and Section 2.2, however, the Bank did not at this time anticipate the scale of the forthcoming reduction in voluntary capital flows to LDCs. This meant that it underestimated the scale of the reduction in absorption that was required, and explains some of the optimism about high levels of investment during adjustment.

Coupled with this misunderstanding of the magnitudes involved in the coming adjustment process, and also stemming from the bias towards the global dimension, was a tendency to overlook the importance of domestic disequilibria. Little attention was given to inflation, although it was widespread and detrimental to both long-term investment and the welfare of the poor, both of which were important for the Bank's proposed adjustment mechanism. The view of the macroeconomic strategy was simplistic - possibly because the availability of abundant foreign finance had the same effect on Bank economists as on governments, namely to make the need for radical policy reform appear less urgent.

So, while the Bank played an important and original role in raising the profile of stabilization issues in those early years, there were still lessons to be learned. In a 1986 "Review of Experience" with the Structural Adjustment Lending strategy, the Operations Evaluation Department (OED) concluded that while many of the microeconomic reforms were quite successful, there were widespread problems with devaluations that failed to be implemented (either because the nominal devaluation itself just never took place or because the rate of inflation exceeded expectations and the nominal devaluation translated into a real appreciation) and with the speed of budget deficit reductions. These formed the backbone of the macro stabilization programme and, in their absence, positive results elsewhere might be short lived. The study reviews nine countries to which SALs were made between 1980 and 1983, namely Turkey, Kenya, Bolivia, the Philippines, Senegal, Guyana, Ivory Coast, Thailand and Jamaica. "Except for Turkey, no other country significantly improved the competitiveness of its exchange rate at the start of its structural adjustment program. Real exchange rates appreciated in Jamaica, the Philippines and Thailand in the year following approval of their first SALs." (World Bank, 1986a, p.xv). As for fiscal restraint, "only the Ivory Coast achieved a dramatic improvement in its budget. The relatively poor performance in other countries appears to have partly reflected an underestimation of the time required for such reforms, and difficulties in maintaining revenue shares in weak economies experiencing inflation." (World Bank, 1986a, p.xv).

When Anne Krueger became Chief Economist and Clausen replaced McNamara as President, in 1982, there were some noticeable changes in the dominant views held at the World Bank. The most important one of these with respect to adjustment was that the emphasis on macro aspects was replaced with a more detailed look at the structures of the economy. Long-term microeconomic reforms of the supply-side, i.e. of the institutions and

ways in which markets operate in developing countries, became a central focus of discussion at the Bank. These will be discussed in section 5.

There were changes within the macroeconomic sphere too. August 1982 had come and gone, and the WDR 1983 was the first one to use the expression `Debt Crisis'. Statistics on indebtedness gradually replaced in prominence those related to oil consumption and energy production. The balance between external (or global) causes and domestic policy errors in the Bank's `allocation of blame' was sharply reversed. Whereas in 1982 it used to be the case that "The developing countries, despite the rise in their current account deficits from U$40 billion in 1979 to U$115 billion in 1981, have been much more successful than the industrialized countries in adjusting to the new situation." (WDR 1982, p.7), in 1986 it was thought that "at the root of the poor performance and debt problems of developing countries lies their failure to adjust to the external developments that have taken place since the early 1970s, coupled with the magnitude of the external shocks." (WDR 1986, p.33). I.e. while a few months before the Mexican default the Bank thought not only that LDCs had adjusted, but in fact that they had done so better than others, a few years on, despite many impressive reversals of current account deficits by countries willing to sacrifice the standards of living of their present and future populations for external equilibrium, they had "failed" to adjust.

On the other hand, the accumulation of practical experience of adjustment programmes, not least from the SALs, led to a greater understanding of the complexities involved. The key recommended policies were still devaluation aimed at a single, market determined exchange rate which was compatible with current account balance; fiscal restraint aimed at a budget balanced over the medium term; financial liberalisation aimed at market determined interest rates, which reflected the real opportunity cost of capital, and overall market liberalisation (details of which are the subject of section 5). But awareness grew of the various reasons why the implementation of these policies could be very difficult. In 1984 inflation was raised to a higher profile within the group of targets for adjustment. The role of the 'inflation tax' in financing the budget deficit as an 'easy alternative' to raising taxes or cutting expenditure was discussed, and analysis of the political economy led to the view that the `inflation tax' was superficially attractive because it is less easily identifiable as a tax, and because those it affects most tend to have the least political clout.

In 1987, Barber Conable takes over from Clausen as President, and Krueger is briefly replaced by Benjamin King, before Stanley Fischer becomes Chief Economist. The Bank's emphasis on the overriding importance of "getting prices right" is not reversed, but progressively more attention is paid to distributional issues and the effects of adjustment on the poor, recapturing some of the elements of the concern with human development of the late 1970s and early 1980s. This process culminates on the WDR 1990, which was entirely devoted to poverty and included much on the effects of stabilization and adjustment.

On the analysis of macroeconomic stabilization itself, the Bank continued to seek a deeper understanding of the short-term dynamics of the interaction of different policies. From the outset, it had been clear that the comparative statics of adjusting to a reduction in large external transfers, manifested through a large current account deficit, were not complex. The required policies were a devaluation and a reduction in fiscal deficits. But the experience from SAL countries suggested that implementation was politically difficult, and that the dynamics of transition might not be so simple. Some issues to receive increased attention were therefore the importance of expectations and credibility, as well as timing and sequencing of policies.

The importance of expectations was raised in connection with the problem of stimulating the reflow of flight capital to adjusting countries. Although the discussion in the WDRs did not use this terminology, it was concerned with the existence of Pareto-rankable multiple equilibria in a game where strategies were amounts of flight capital to be re-invested in an LDC and payoffs were returns that depended, inter alia, on the general macroeconomic climate and the aggregate level of investment in the country. This game displays externalities and strategic complementarities and hence has potential for coordination failures (see Cooper and John, 1988, for the general properties of such models, and Dornbusch, 1990, for a specific application). The Bank's aim of affecting expectations could be seen as an attempt to overcome those failures and move to a high-investment Pareto-superior equilibrium. While the Bank's own research did not contribute to the theory of coordination failures, it certainly contributed to the dissemination of the issue amongst both the general public and many policy makers. This dissemination drew particularly on the experience of Mexico, which received significant repatriations of funds shortly after the Brady deal in early 1990.

The importance of government credibility was illustrated by the increasing difficulty encountered by the Argentine and Brazilian governments in their fight against inflation in the late 1980s. As public confidence on the government's ability to reduce inflation fell with each unsuccessful plan, the economy became more comprehensively indexed, expectations of future inflation led to higher interest rates and these pushed up costs for borrowing firms. In addition, consumers increasingly attempted to convert wages into goods as soon as they earned them, so as to protect their value. Both cost and demand effects combined to lead to faster price rises than would otherwise have been the case.

Issues of sequencing gained in importance partly as a result of the competition of instruments problem. Because it was understood that different policies - intended to affect distinct target variables - often have contradictory side effects on the targets, the order in which they are implemented matters. The official position was to recognise that parameter values vary widely across different countries so that, even if the basic structure of the model relating instruments to target variables were applicable to all, the quantitative responses would still vary and the timing and sequencing of programmes must be decided in view of each particular circumstance. Nevertheless, "the importance of this sequence of reforms - reforms to reduce severe macroeconomic imbalances first and to improve resource allocation and restore growth later - has become increasingly clear with experience." (Corbo and Fischer, 1990, p.3) The main reason for this is that the thrust of the microeconomic reforms of the supply-side is to encourage greater efficiency of investment through adequate relative prices. Under high and unstable inflation, however, or unpredictable exchange rates, relative prices are unclear. This underscored the importance of sustained macroeconomic stability.

5) Adjustment and the Efficiency of Resource Allocation.

This section deals with the World Bank's contribution to the analysis of allocative efficiency in the context of adjustment. From the outset the third key policy recommendation of the WDR (1981), namely to increase the efficiency of investment, already revealed a concern with microeconomic issues. Indeed, even the two basic components of the macroeconomic programme led to a progressive deepening of this interest in the microeconomics of the supply-side. The first was the need to permanently reduce the current account deficit, which required a transfer of resources from the

production of non-tradeables to that of tradeables. In order for resources to move into those activities where they could be most productive, it was necessary that the structure of incentives facing investors, producers, consumers and workers should reflect opportunity costs. In other words, prices should move towards their shadow values. In the context of highly distorted economies, many of whom had altered incentives purposefully to encourage the development of domestic industry, this perspective was translated in practice into the encouragement of price and trade reforms.

The second macro feature was the need to reduce fiscal deficits. This not only led to a move towards higher prices in the public sector (many of which had been below marginal costs), an element of price reform, but also to the realisation that both sides of the budget - collection of revenue and control and allocation of expenditure - were often inefficient. The revenue side was to be dealt with by tax reform, whereas the expenditure side could be tackled by reforming institutions and management practices throughout the public sector. The need for these reforms had been widely recognised, partly due to the short run macro pressures, but it was also argued that the reforms would be fundamental in laying the foundations for more stable long-run growth in the future. Structural adjustment, the business of reforming the microeconomic structure of developing societies to encourage the efficient use of resources over the long term, became an integral part of any stabilization programme and was, in time, to overtake it in perceived importance, so that the latter would be seen primarily as a prerequisite for the former. Given its longer-run nature and its effect on the `supply side', it was perceived as closer to the remit of the Bank than short-term stabilization.

Although this process was not completed until later in the decade, under Clausen and Krueger, its roots can be found in the earliest attempts at implementation of the SALs. They were designed around four key components, namely trade reform; "resource mobilization", an euphemism for fiscal reform; reforms aimed to increase the "effectiveness of resource use"; and "institution building". The fist two components involved macro policy elements, such as devaluations and fiscal contractions, but trade reform very much focused on the effects of existing trade policies and legislation on the efficiency of resource allocation and of production. "Resource mobilization" explicitly targeted public sector pricing and public enterprise efficiency as means to reduce the fiscal deficit.

The last two elements are entirely aimed at greater allocative and productive efficiency throughout the economy. Given the problems with the implementation of the macroeconomic components of these early SALs, mentioned in the last section, it is not surprising that the Operations Evaluation Department found that the most successful elements of most programmes were the last two. The main areas where "effectiveness of resource use" was fostered were agriculture and energy conservation. In Turkey and Senegal, significant increases in producer prices of food crops were encouraged, to place them in line with international prices and compensate for the abolition of subsidies on fertilizers and other inputs. Attempts to reduce the effect of these policies on the urban poor involved projects for greater marketing and transporting efficiency, aimed to reduce the spread between producer and market prices. The effects on the efficiency and level of domestic supply were deemed satisfactory by the OED. It must be noted, however, that raising prices can only provide the incentives for the reallocation of resources towards greater efficiency. Empirical evidence of the greater efficiency itself must be found in the actual movement of factors of production to the relevant sectors, where their productivity valued at shadow prices must be greater than that which they previously displayed. Whilst there is evidence that movement into agriculture took place in Turkey and Senegal (see World Bank, 1986a), it is not obvious that careful studies to value their productivity have been carried out.

Institutional reform was perhaps the element of the programmes with the longest lag before returns could be measured. It was recognised that "there is an obvious mismatch between the time frame of SALs and the number of years that may be necessary to complete institutional reforms." (World Bank, 1986a, p.xviii). Nevertheless, a positive assessment of these reforms was based on the view that progress was being made on various fronts. Subsidies to higher education were lowered in Ivory Coast (see Fields, 1975, for an early theoretical justification), government employment was rationalized in Jamaica and there were "improvements in budgeting, management control systems and the efficiency of public investment in most SAL countries." (World Bank, 1986a, p.xxv). The main difficulties identified by the OED Review were insufficient time frames and poor policy coordination across the various elements. For example, failure to devalue meant that tariff reforms could not proceed at the desired pace, at the risk of increasing trade deficits; deflations led to shrinking government revenues at the same time as tax collectors underwent extensive training (as in Jamaica, prior to the introduction of new domestic

taxes in 1985). These examples reinforce the importance of careful timing and sequencing of the reforms. If tax collector training had preceded the macroeconomic deflation, the effects on revenue might have been less severe, thus enabling greater government ability to proceed with other aspects of the adjustment programme. Nevertheless, valuable learning in the design and implementation of these programmes was taking place and there is no doubt that the shift of emphasis towards the efficiency aspects that were to characterise the next five years, both at the Bank and elsewhere, owed a great deal to the evidence from these practical experiences.

This greater emphasis in 1983-87 is evident even from the choice of WDR themes. Of the five WDRs from 1983 to 1987, three were devoted to issues directly related to microeconomic or institutional reforms: in 1983, the topic was "Management in Development"; in 1986, "Trade and Pricing Policies in World Agriculture" and in 1987, "Barriers to Adjustment and Growth in the World Economy" as well as "Industrialization and Foreign Trade". Although the 1985 issue was dedicated to "International Capital and Economic Development", the approach adopted emphasised strengthening capital and securities markets in developing countries and allocating resources from borrowing in an efficient manner, so as to equate the expected present value of the stream of returns from investing the marginal dollar borrowed to the expected present value of its servicing requirements. The collapse of lending and the stark reality of investment cuts and GDP declines across the adjusting developing world became clear during this period, destroying earlier hopes that the quantity of resources available for growth would continue to increase, albeit at a slower rate. This perceived scarcity imposed even greater urgency upon improving the efficiency with which available resources were used. The emphasis was on microeconomic reforms and on "getting prices right".

Naturally, the Bank did not itself produce the theory on which the policies it was recommending were based. Indeed most of the reforms advocated by the Bank at this stage had been proposed much earlier. Little, Scitovsky and Scott (1970) already suggested "...that developing countries would benefit from adopting, in general, a more decentralized approach with greater use of the price mechanism; and, in particular, given that there are good prospects for exports, a more open approach for foreign trade, with less protection and use of controls." (p.21). Bela Balassa and his associates had also been pointing to the need for trade and price reform to increase the efficiency of the supply-

side for almost two decades, often as consultants to the World Bank. Balassa et al (1971) already discuss static and dynamic costs of an import substitution strategy, and suggest mechanisms for reform employing a specific sequence of devaluation and tariff reductions.

Whilst there are differences in the end-state advocated by Balassa and that favoured by Krueger's team at the Bank in the mid-1980s, there is little doubt that the direction of the reforms outlined below had been developed earlier. And both Little et al (1970) and Balassa et al (1971) point further back to the influence of others, such as Harberger (1958) and Johnson (1965). The microeconomic theories now summoned to support the reform proposals were firmly established. The Bank's innovations were, first: applying them in the context of structural adjustment, thereby changing its nature from an essentially macroeconomic process to one of more fundamental economic reform. Second, the Bank helped disseminate a number of basic principles from existing theory, in a form helpful to policy makers and implementing institutions which may have previously been less than fully acquainted with them. Whilst, as we will see, there were cases in which theory and Bank advice diverged, these divergences were generally less serious than those between theory and the existing practice that the Bank was trying to change. Its advice could, in many of those cases, be considered a move in the right direction.

Advice from the Bank on policies to increase efficiency in the adjusting economies in the 1980s can be grouped into seven interrelated areas: trade reform, price reform, tax reform, financial liberalization, privatization, labour market reform and institution building.

Trade reform was essentially aimed at strengthening or creating an environment of prices, regulations, tariffs and other signals such that the incentive to produce commodities for export was no less than that for producing them for the domestic market. Three stages were envisaged: first a replacement of quantitative restrictions by tariffs. This increases revenue, diminishes rent-seeking and corruption opportunities and should be possible to implement at the outset. On stage two, the variance across tariff rates would be brought down, in an attempt to prevent the Effective Rate of Protection on certain goods to be disproportionately high. Lobbying groups might make implementation politically difficult. Stage three would proceed to a gradual downward movement in the general level of tariffs, exposing domestic industry to competition. Simultaneously, export incentives would be created to compensate for the bias in favour of import competitors arising from

the remaining tariffs. (see World Bank, 1986a)

The implementation of this strategy ran into a number of problems in different countries. As mentioned in Section 4, a failure to devalue threatens the later stages of the reform, and this was common in a number of African and Latin American countries in the early 1980s. Political pressure was an obstacle in certain cases, as in Brazil. But there are success stories too, both old and more recent. South Korea adopted a strategy very similar to the one outlined above and its experience was influential in prompting the Bank and other analysts to suggest it to others. More recently, Malaysia, Indonesia and Thailand have embarked on a similar course with apparent success. The long-term benefits of an outward oriented growth strategy had also been the subject of a lively debate, and reviews of the evidence were decidedly coming to favour it (note the change between Chenery, 1979 and Chenery et al, 1986, where in the former, judgement between strategies was deliberately reserved, whilst in the latter trade orientation was more explicitly given `high marks').

One point on which the theory might differ from the scheme above is the uniformity of ERPs. The efficiency criterion sought is essentially efficiency in production, in terms of the allocation of factors to meet domestic and foreign demand sources. The inadequacy of ERPs as indicators of divergence from opportunity costs[25] means that uniformity of ERPs is not a valid objective from the perspective of efficiency (see, e.g. Ahmad and Stern, 1989, p.1059). However, as with other areas where the Bank did not fully absorb existing theory in its suggestions, it seems likely that the policies emerging from this criterion represent moves in the right direction.

Price reform was aimed predominantly at public sector prices and agricultural prices. The Bank recommended that the former should be raised to equate marginal costs, from their levels so commonly below them. This is in line with theory for intermediate goods, but not for final goods (see Stern, 1987). In the absence of perfect lump sum taxation, there is no reason why there should not be an element of indirect taxation in the price of publicly supplied final goods, equivalent to that imposed on goods supplied by the private

[25] Essentially because effective rates of protection are calculated on the basis of market, rather than shadow, prices.

sector. But again, given the existing distortions and their importance for public sector deficits, the suggested moves were in the right direction. Agricultural prices should be brought to their world levels, as a proxy for their shadow values. These adjustments were tried in a number of countries, with positive supply responses, but with some unattractive equity effects in the cities (see World Bank, 1986a).

As for tax reform, the Bank's full public statement came with the WDR (1988), under the title "Public Finance in Development". Here, the Bank elaborated on what it thought were the four key elements for tax reform, namely greater reliance on user charges for services provided by public enterprises; more decentralised spending decisions at state/province or city levels; taking budgetary constraints more seriously in order to acquire a keener sense of priorities in determining spending; and the potential importance of taxation as a means to influence the distribution of income and hence to relieve poverty. In light of this last point, it is curious that some of the other recommendations appear to ignore precisely that concern with equity. This is the case, for instance, with reliance on user fees for all public services, as we will see in the next three chapters. It is also true of the suggested desirability of uniform indirect taxation. As Burgess and Stern (1993, p.790) point out, the argument is valid only if strong redistributive tools are available and optimally used.

The general direction, however, is again correct. For direct taxation, tax bases should be expanded and marginal rates, often very high by international standards, should be brought down, with likely benefits in both revenue and efficiency. Indirect taxation should move towards the adoption of a final goods tax such as a VAT (see Tait, 1988) - and exemptions and loopholes should be eliminated to increase simplicity, administrative ease and collection levels.

Among the countries to receive advice and/or lending for the implementation of tax reforms from the World Bank, were Mexico and Turkey in the early 1980s, Jamaica in 1984-6 and Malawi in the late 1980s. The results generally included an increase in revenue (except for Mexico), a reduction of evasion and a simplification of the tax structures and payment procedures. They generally involved staff training and better administrative equipment. For a discussion of these and other reforms, see Burgess and Stern (1993).

Financial liberalization included policies to allow the domestic interest rate to be determined in a suitably developed set of capital markets, so that the real interest rate would reflect the opportunity cost of capital. Under standard conditions, with some capital mobility and flexible exchange rates, this should be determined by the world interest rate and the domestic rate of inflation. Most of the evidence has tended to confirm that, while very high real interest rates discourage investment, policies which artificially maintained negative real rates to encourage investment effectively required capital to be rationed, often in a corrupt manner, and ended up allocating capital inefficiently, i.e. to projects with internal rates of return below both the shadow real interest rate and that of alternative projects unable to gain access to loans.

The WDR (1989) elaborated further on reforming financial systems. Their importance as intermediaries between savers and investors was highlighted, and was the main reason why their efficiency was particularly crucial. The Bank's advice went beyond the restructuring of some of the commercial banks which were in financial distress in the late 1980s, and included the creation of a range of other institutions, such as securities and insurance markets, pension funds, and futures markets, all of which would compete with and complement the services provided by the older institutions. They also acknowledged the role of informal financial intermediaries, such as personal acquaintances, pawnbrokers, curb markets and Rotating Savings and Credit Associations (ROSCAs)[26] in reaching and providing valuable services to agents normally outside the scope of the formal financial system. There was some concern with the high real interest rates prevalent in this informal financial sector, although the hypothesis that these could be explained by risk considerations was raised. On balance, the assessment of its role is sympathetic and not entirely out of line with contemporaneous analysis outside the Bank (see for example Chandavarkar, 1989, and Thomas, 1990).

This WDR also included a more detailed analysis of the monetarist experiment of the Southern Cone in the early 1980s. The lessons from its failure led to more cautious advice on the dynamics of liberalizing financial markets. There was now backing for a more gradualistic process, intended to avoid sharp swings in interest rates and the resulting

[26] The WDR (1989) looked, for instance, at the best known example of a successful ROSCA, namely the Grameen Bank of Bangladesh.

instability of capital flows and the exchange rate.

In the 1980s, privatization probably was the most politically contentious of these reforms and, possibly as a result, the Bank was never as forceful in recommending it as in other areas. It suggested that some enterprises would probably be more efficient if managed in the private sector, subject to the discipline of a hard budget constraint. But it was not an advocate of the minimalist public sector. In fact, even in the WDR 1987, which has come to be seen as something of a manifesto, an active role for public sector investment is defended for a number of areas, not very different from the `traditional' ones recently re-emphasised in the literature (see Stern, 1991a). The Report pointed to the lack of more widespread education as the main barrier to industrialization, and considered the infant industry argument for protection valid in some cases - though not in most. It states that "the important question is often not whether to intervene, but how." (WDR 1987, p.7). Little explicit attention, however, seems to have been paid to linking the desirability of privatization to the degree of competition the firm is likely to face (see Vickers and Yarrow, 1988, and Stern, 1991a).

Labour market liberalization was somewhat less well worked out in theoretical terms. There was an emphasis on allowing real wages to be flexible, which had as its main target the practice - particularly common in Latin America - of indexing nominal wages to some measure of inflation. The objective was to allow for smaller falls in employment by permitting real wages to be cut and hence lowering the marginal cost of labour. The Bank also urged reductions in non-wage labour costs, which in many countries accounted for a large share of total labour costs, by international standards.

While these may be sensible practical suggestions, the underlying issues are conceptually complex, both because labour markets function in peculiar ways and because of the obvious welfare implications. Policy recommendations can vary quite starkly depending on the underlying model one believes in. Minimum wages, for instance, are both inefficient and detrimental to the poor in a classical model of the labour market with no frictional unemployment, but may be both efficient (in the constrained sense of maximizing output) and beneficial to (all) workers in models with unemployment arising from a mismatch between workers and vacancies, and where wages are determined by

bargaining (see Pissarides, 1990).[27] The interplay of formal and informal sector labour markets would also have to be considered, as well as the non-financial benefits of formal sector employment, such as work and safety conditions.

Institution building was discussed earlier in this section. During the 1982-90 period, work continued on those initiatives perceived to be successful, and longer time scales were allowed.

6) Adjustment and Equity.

I now turn to the Bank's analysis of the distributional impacts of adjustment, and particularly of its effects on the poor. Until 1987, its contribution was mostly in terms of improving the quality and coverage of data collection, principally through the Living Standards Measurements Study (LSMS) programme. The data sets collected then enabled researchers at the Bank and elsewhere to gain substantial insights into the distribution of incomes in a number of countries for which little reliable empirical work had previously been done. But this period saw little evidence of analytical work at the Bank on the channels through which the policies discussed in the two previous sections would affect the living standards of the poor.

From 1979 to 1982, there was interest in the repercussions adjustment might have on human development. The text of the WDRs revealed awareness of the basic impacts, such as that cutting subsidies and other forms of expenditure would harm those who previously benefitted from them; or that raising farm gate prices in agriculture would probably have a beneficial effect on poor farmers (and rich farmers, for that matter), provided they were net sellers. But the optimism which pervaded their projections of the adjustment experience at the time also had implications here. If growth rates had been as high in the 1980s as they had predicted (see Table 2), and capital inflows had continued at the expected rate, then the necessary internal adjustment programmes would have been less severe, and their effects on output, employment and poverty less dramatic.

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[27] In Pissarides's model, a minimum wage is not necessarily efficient. But the market-determined wage rate may be below the efficient wage, which allows scope for a competent and well-informed government to act.

In chapter 7 of the WDR 1981, entitled "Human Development: a Continuing Imperative", they note that cuts in social spending had already been implemented in Brazil, India and Turkey, with a negative effect on the living standards of the populations concerned.[28] They urge governments to realise that human capital formation is fundamental for the future growth prospects of their countries, and hence to continue funding social expenditure on education, basic health, nutrition and training.

There was, however, no conceptual discussion of the different mechanisms through which stabilization could affect income distribution, such as that by Johnson and Salop (1980) who, although themselves also optimistic, had identified many channels for impact. These included: relative price effects on producers in the traded and nontraded sectors; fiscal restraint, which would affect people differently depending on how they benefitted from expenditure and on the incidence of tax increases; the effect of liberalization on relative prices; reduction in total domestic credit and capital market imperfections, which might combine to lead to lower credit to smaller investors; and the effects on employment. Judging from the discussions in the World Development Reports - including the 1981 volume, whose main theme was adjustment - or in the public pronouncements of the President, this kind of analysis was not going on at the Bank at this time.

The distributional changes associated with the implementation of the early SAL programmes may, in part, have been connected with this absence of serious ex-ante analysis. The decline in real wages for the duration of the programme in Turkey - which was presented as a good performer on this count - was of 28%. Declines were also recorded in Jamaica and Senegal. For most other countries, data weaknesses prevented analysis. In general, the Bank postulated ex-post that "the income distribution effects of the changes these countries have experienced have tended to be in favour of the owners of capital and, at least in the Ivory Coast, Senegal, Jamaica and Thailand, in favour of the farmers and the rural sector." (World Bank, 1986a, p.xxvii).

Meanwhile though, on the empirical front, LSMS Working Papers were first published in 1980 and around ninety were made available until 1992, in a significant contribution to

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[28] Quantification of these effects would have generally been unreliable, due to the scarcity of sufficiently recent data.

work in and outside the Bank. Nevertheless, the fact that twenty papers were published between 1980 and 1982, none between November 1982 and March 1985, only seven between March 1985 and March 1987, fifteen in 1987 alone and thirty-seven between May 1988 and 1990 can be seen as indicative of the evolution of the importance given to equity issues which took place within the Bank during the decade.[29] (Source: World Bank, "LSMS Working Paper Series List", 4 November 1991; updated August 1992).

Unlike the analysis of allocative efficiency issues, there was little progress within the Bank in this area from 1982 to 1987. There was, of course, a correction of the overoptimistic predictions made before the onset of the debt crisis in 1982. The WDR 1984 notes the decline in per capita income occurring in a number of countries, as well as the cuts in investment in general and expenditure on social programmes such as education and health in particular. It warns that these will have negative long-run effects on growth prospects (pp. 32/3). But as regards remedies, it limits itself to the hope that efficient pricing and outward orientation would suffice, in due course, to raise incomes and hence diminish the level - or reverse the growth - of poverty: "With a continuation of slow growth, millions of people in many developing countries will become progressively poorer; with faster growth, almost everybody in the world will enjoy some increase in real income." (p.38). This marked a shift from the view - prevalent under McNamara - that growth was instrumental to reduce, but not sufficient to eradicate, poverty: "The pursuit of growth without a reasonable concern for equity is ultimately socially destabilizing." (McNamara, 1981, p.656).

Possibly because the issue was no longer regarded as a priority, there was also not much effort to update the concepts involved in their appraisals of equity. Their measurement of poverty was the headcount index, i.e. the share of the population with incomes below a given poverty line, and there is little evidence in the WDRs of attempts to incorporate insights from the debate on poverty measurement that was taking place contemporaneously. For two examples of comprehensive criticisms of the headcount and

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[29] A counter-argument which has been presented verbally to the author by persons closely associated with LSMS at the time is that the fall in the frequency of publication in 1982 was due to a move from theorizing about data collection to actually performing it on the ground, thus providing a more valuable service to measuring the living standards of the poor.

suggestions of alternatives, see Sen (1983) and Atkinson (1987). Academic economists were very productive during the 1980s on the intricacies of measuring poverty and inequality. Despite the high value the Bank usually gives to having reliable data, it was not clear from its leading publications that the Bank's researchers had incorporated these advances in measurement at the time.

The Bank concedes to having been a belated follower on questions of policy remedies as well. As the WDR 1990 puts it: "it was UNICEF that first brought the issue [the effects of adjustment on the poor] into the centre of the debate on the design and effects of adjustment." (p.103). A collection of some of the work that was being done at UNICEF during the middle of the decade is Adjustment with a Human Face, by Cornia, Jolly and Stewart (1987). The two volumes include ten detailed case studies, supplying valuable empirical evidence. It is a long and complex treatment of the problems involved, and can not be done justice here. Its main merit was to highlight the very significant transformations that were occurring in the lives of millions of people, as a somewhat ignored side effect of the adjustment medicine, and to earn widespread acceptance - over a period of time - that direct intervention to protect the more vulnerable was warranted. It proposed a menu of policies aimed at relieving poverty under adjustment. This included: more expansionary macro policies; the use of sectoral or meso policies to target scarce resources to those most in need, e.g. credit schemes for the informal sector; restructuring public expenditure towards an increase - not only a maintenance - of the social programmes and investment in the human capital of the poor; compensatory programmes such as public employment schemes and nutrition projects, essentially to work as temporary direct government transfers; and the careful monitoring of the nutrition, health and education situations across the relevant country, to provide for speedy action if critical levels were to be reached.

The macroeconomic component of the programme was based, like the pre-1982 Bank predictions, on the resumption of external financing to the adjusting countries. In the absence of increased external finance, which would allow for a current account deficit greater than previously expected, an increase in the fiscal deficit - which must be what is implied by a 'more expansionary macro policy' - can only come if it is financed by domestic borrowing in the capital markets, which crowds out private investment, or by borrowing from the Central Bank, increasing the inflation tax and thus reducing

consumption, particularly of the poor. The real challenge of adjusting to lower current account deficits did not lie in hoping for an impossible macro expansion, but instead in facing the task of restructuring expenditure and taxation in order to allocate the scarce resources to those - if the concern is equity - who need it most. This is a criticism to which the manner in which Cornia, Jolly and Stewart treat both the level and allocation of resources at a macro level is vulnerable. Other elements of their programme, however, were soon accepted by many outside UNICEF, including the Bank.

Even if it was a follower in terms of its own views, the Bank nevertheless played a constructive role in facilitating some important research into the distributional aspects of adjustment. Demery and Addison's (1987) thematic study of the possible mechanisms for "the alleviation of poverty under structural adjustment" was published by the Bank. They were more realistic in their views of the macroeconomic scenario than Cornia, Jolly and Stewart (1987), and presented an interesting `menu' of approaches to relieving hardship under adjustment. It was based on the distinction between `primary' and `secondary claims' on resources (see Stewart, 1983), i.e. between income from productive activities and income from transfers. The latter is seen as a `last resort' and they focus on means to increase the primary claims of the poor in the context of the adjustment policies, through a combination of: (i) increasing their access to assets (e.g. land and credit reforms); (ii) raising returns on assets held by them (e.g. agricultural price reforms); (iii) improving their employment opportunities; and (iv) investing in health and education. They also consider the experience with transfers, as a last resort, and in particular nutrition programmes. Their emphasis throughout is firmly on the need for careful targeting of scarce resources.

Much of the evidence on which Demery and Addison (1987) draw, originates from programmes in which the Bank had been involved in the mid-1980s, such as the Thai SALs of 1982-84, the Chilean SAL of October 1985, assistance to employment and training programmes in Senegal in 1986/7, and others. It could be argued that a pattern emerges, of empirical evidence from the monitoring of Bank programmes becoming highly instrumental to the formulation of ideas by researchers sponsored by or associated with the Bank, which are then absorbed by the `official view' with a lag.[30]

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[30] It should also be mentioned that Demery and Addison's preliminary research into this topic was carried out earlier, with ODI support. (see Addison and Demery, 1985.)

Thus, with fifteen LSMS working papers issued, Demery and Addison's work and the public response to Adjustment with a Human Face, 1987 marked a revival of the interest in distributional and equity issues within the World Bank. This continued during the last years of the decade, and into 1990. The World Development Report (1990) was devoted to Poverty and marked a return to the Bank's earlier emphasis on distributional and standard of living issues.

Dealing specifically with the effects of adjustment on poverty, Chapter 7 of the WDR 1990 recommends a mix of policies based on two key elements: "(1) swift action on certain fundamental policies that are designed to provide the context for future growth and (2) macroeconomic policies that can moderate reductions in private consumption in the transition period." (p104). Structural adjustment is seen as compatible with the reduction of poverty in the long-run, for two basic reasons: (i) it will allow faster growth and (ii) the restructuring of production generally involves an increase in the relative price of tradeables. In many cases, particularly in Africa and Asia, agricultural exports are produced by the rural poor, who hence benefit.

In the short-run, it was argued that deregulation and liberalisation can also help the poor. In particular, raising farm gate prices to world levels, besides reducing a source of allocative inefficiency in the incentive structure, helps the poor producers of the goods. This has been documented in Malawi (maize) and Nigeria (cocoa) for example. Even then, however, there may be losers amongst the very worst off. Farmers who are net consumers of food often comprise the poorest rural stratum, and they stand to lose from price liberalisation. This points to the need for very careful targeting of social expenditure and transfers, even in the areas where adjustment might have been expected to aid the poor immediately.

But, as the Report readily concedes, there are still grounds for serious concern with the short and medium runs, for at least two reasons. First, following expenditure-switching policies, industries and markets take time to respond to permanent changes in relative prices (so that, essentially, the shift of labour and capital from the previously protected nontradeables to the tradeables sector is a slow and possibly difficult process). Unemployment and informal sector employment may grow as a result, and wages in both sectors may fall. Second, the expenditure reduction policies threaten social programmes,

such as expenditure on health, education or basic infrastructure, which are essential to provide the poor with income earning opportunities. And it also threatens expenditure aimed directly at supplementing the income of the poor, such as food subsidies and/or direct transfers.

Their policy recommendations for dealing with these problems were based on the three following basic points:
(i) Cushioning the fall in consumption for the poorest. Macroeconomically, this could be achieved by allowing for a "pause" in investment, provided the basis for its recovery exist.
(ii) "Maintaining physical and human capital", by keeping programmes on human and basic infrastructure going.[31]
(iii) "Preparing the way for a recovery in investment".

Finally, the merits of raising transfer levels during adjustment were discussed. Even if social programmes are maintained and rural incomes rise as a result of farm produce price liberalisation, it is likely that the overall reduction in expenditure and hence in economic activity will harm the poorest people in society. The Report argued that the principal channel for that is the reduction in demand for labour, and that this is likely to be particularly severe in the cities, where industry could suffer both in the short-run and as a result of permanent changes in the incentive structure. Hence, there may be a case for an increase in transfers. This can take three forms: subsidies, public employment schemes and compensation for laid-off workers.

Although the general emphasis throughout the Report is on means to increase 'primary claims', rather than on providing transfers, some interesting evidence is presented in support of employment schemes which, having very low wages, embody a self-selection mechanism. Examples of where these schemes also contributed to labour intensive projects to upgrade local infrastructure include ESF in Bolivia and PAMSCAD in Ghana. But design must be very careful, in particular as regards targeting. Bolivia's ESF, because it paid market wages, was assessed to have no more than half of its workers drawn from the

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[31] Indonesia and Chile were cited as examples of adjustment experiences in which reductions of public deficits were achieved without compromising expenditure on basic social programmes.

bottom 40% of the income distribution. In contrast, Chile's programme was thought to have 2/3 of its workers coming from the poorest 20% of society in 1986/7. Given a very tight public budget constraint, the question of targeting is central not only to employment schemes, but to any government expenditure aimed at relieving hardship for the very poor.

Although the WDR is not rigorous on the incidence of the inflation tax, simply stating that: "The `inflation tax' is probably much more regressive than traditional tax instruments", systematic analysis of the evidence for particular countries has been done at the Bank or in Bank sponsored studies. "Peru: Policies to Stop Hyperinflation and Initiate Economic Recovery" (World Bank, 1989a) is an example of an internal Country Study that does this and Gil Diaz (1987) presented, in a World Bank sponsored publication, estimates of the incidence of that `tax' in Mexico.

All in all, the Bank's contribution to the analysis of the distributional consequences of adjustment was not particularly original. Until 1987, it mostly provided useful empirical evidence. This was of two distinct types: case study material from tracing the effects of its own SAL programmes in countries like Chile, Ivory Coast, Jamaica, Thailand and Turkey; and detailed household survey data in a different but overlapping set of countries, which were the object of LSMS studies. After 1987, responding to works sponsored by UNICEF and by themselves, the Bank focused more closely on the impacts of the policies on the poor, and the dedication of the WDR (1990) to Poverty epitomized that concern.

7) Conclusions.

In this chapter, I have examined five important analytical themes relating to international debt and structural adjustment during the 1980s, and reviewed the World Bank's views on them. In so doing, I have tried to form an assessment of the importance and originality of these views in light of the wider debate. Whereas it appears that the Bank was not particularly original in its approach to the debt crisis, it did play an important leadership role in the design of structural adjustment programmes.

Regarding the debt crisis, three main conclusions can be drawn from our discussion. First, it appears that the Bank's attitude towards the rapid growth in the level of the external obligations of many developing countries in the late 1970s was misguided. Their view that

deficits implied resource transfers, while definitionally correct, neglected that repayments meant that these transfers would in future be reversed, and that whether this was on the whole advantageous depended on what was done to the resources in the meantime. It effectively constituted an endorsement of the high borrowing strategy which led so many countries to be viewed as financial pariahs in the 1980s. Furthermore, the Bank's views on the wisdom of borrowing and using the borrowed funds to smooth absorption (consumption as well as investment) suffered quite a change sometime around 1982-83.

Second, from 1982 to their Conference on Debt in 1984 and the advent of the Baker strategy in March 1985, the Bank was unoriginal in terms of proposing solutions to what had by then become the greatest immediate obstruction to a resumption of growth and development in a large number of countries. It shared the concerns of most of the profession with insufficient levels of lending, due to free-riding in a multi-lender framework, and with the short-term nature of most rescheduling deals.

Finally, from 1985 to around 1988, there was a further worsening of the Bank's record as a follower of the debate. This was a time when the balance of academic opinion was changing towards recognizing the necessity of some debt relief, or forgiveness. This was influenced by Dornbusch's (1985) suggestion that the crisis did, in a sense, reflect a solvency problem, and even more so by Sachs (1986), which contained an early discussion of the debt overhang hypothesis. As we have seen, very senior officers at the Bank were quite prepared to recognise, at the 1989 Conference, that the institution had been constrained to the role of supporting the Baker strategy at a time when it was becoming clear to the informed public that debt reduction was an urgent necessity. As Stanley Fischer admitted from the Bank:

> "...academic research, writing and opinion have been far more influential on the debt issue than the academics may believe, or than officials like to pretend, for the academics are unencumbered by the official need to support the official strategy. It was academics who were first to point out that the stabilization focus of the programs imposed on debtors to deal with the debt crisis from 1982 to 1985, while necessary, was not sufficient for growth." (Fischer, op.cit, in Diwan and Husain, 1989).

As for structural adjustment, the Bank's contribution was different in three different areas.

On stabilization policies, the Bank concurred with the general advice: a real devaluation was required to bring about expenditure switching from non-tradeables to tradeables, and a fiscal contraction was needed to bring about the expenditure reduction required by the reduction in external transfers to the countries. But until 1982/3, the Bank maintained predictions about availability of voluntary capital flows to developing countries which in the event turned out to be wildly optimistic. Because of this, it advised a 'high investment' mode of adjustment which in retrospect sounds somewhat farfetched.

From 1982 onwards, two things became evident: that large trade surpluses were necessary, so that adjustment would have to take place with developing countries exporting capital; and that although the comparative statics of stabilization may be simple, the dynamics of its implementation were not. The Bank became increasingly aware of issues of timing and sequencing of policies, and of the importance of political constraints and intangibles such as expectations and government credibility.

The area in which its contribution was most important was the design of structural adjustment policies aimed at increasing the efficiency of resource allocation. These were microeconomic reforms of the supply side, and in time came to be seen as the main components of the package, for which macroeconomic stabilization was essentially a pre-requisite. Based on its experience with the implementation of various SALs, the Bank's advice after 1982 emphasized 'getting prices right', through a combination of trade, price and tax reforms, labour and capital markets liberalization, privatization and institution building. These became regular features of all programmes the Bank backed, and indeed of the general perception of what adjustment was about. The theory used was standard material, and even its application to policy reform in developing countries had been suggested earlier by Balassa et al (1971) and by Little, Scitovsky and Scott (1970). Nevertheless, the initiative to put these reforms into practice in the context of the economic overhaul required by the shocks of the 1970s and 1980s was largely taken by the World Bank, and the shape of reform of the supply side in many countries was heavily influenced by its advice.

In the field of the distributional impacts of all these policies, the Bank was not a leader. Despite a genuine commitment to the idea of 'human development' in the McNamara years, the misguided belief in continued foreign capital inflows and the absence of a clear

analytical understanding of the large potential for distributional effects of the policies already being considered caused concern with the poverty impact of adjustment to be rather muted in those early years. No significant improvements were made until 1987, and when they were, it was in response to work done elsewhere, particularly at UNICEF. The last three or four years of the decade did see much more attention being paid to distributional issues, culminating in the Poverty WDR of 1990. Separately from what was happening to its dominant views, though, the Bank did sponsor a major empirical initiative on this issue, through the Living Standards Measurement Study programme.

These concluding observations summarize a brief investigation into the intellectual history of a large institution at the centre of structural adjustment in the 1980s. Most of what we have learned is about analytical strengths and weaknesses of that institution as it faced the debt crisis and the process of adjustment that followed. But in doing so, I have also sought to gain an insight into the complexity of structural adjustment and of the myriad ways in which it affects the living standards of the poor. The next three chapters in this thesis are different in nature from this one, but they focus on one possibly important channel through which a revision of the role of the state, undertaken in the context of structural adjustment, might affect the long term distribution of income, as well as poverty.

CHAPTER 3

ROADS TO EQUALITY:
WEALTH DISTRIBUTION DYNAMICS WITH PUBLIC-PRIVATE CAPITAL COMPLEMENTARITY[1]

Abstract: This chapter proposes a model of wealth distribution dynamics with a capital market imperfection and a production function where public capital is complementary to private capital. A unique invariant steady-state distribution is derived, with three social classes: subsistence workers, 'government dependent' middle-class entrepreneurs and 'private infrastructure owning' upper-class entrepreneurs. It is shown that there is a minimum level of public investment below which the middle class disappears, and that increases in non-targeted public investment over some range lead to unambiguously less inequality of opportunity, as well as to greater output. This provides an additional rationale for an active role for the government in infrastructure, health and education provision, and has implications for foreign aid.

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[1] This chapter is a revised version of STICERD Theoretical Economics discussion paper TE/95/286.

1) Introduction:

Should the state be an active player in economic development, or should governments aim instead for a continued reduction in the share of their expenditure to GNP? In particular, how will changes in the 'size' of government affect the distributions of wealth and income? Can public investment projects which are not targeted specifically at the poor nevertheless contribute to alleviating inequality and poverty?

In the 1980s, the experience of structural adjustment discussed in the last two chapters led a large number of developing countries to reduce government intervention and seek a greater role for the private sector, even in the production of goods and services which had previously been the preserve of the state. This tendency may have originated from the macroeconomic need for expenditure reduction (see Chapter 1-3), but it often evolved into a long-run development strategy, based on a greater role for private agents interacting through markets and a less active government. It was part of a rising trend of thought in development economics, which has been described as follows: "More recently, the pendulum has swung the other way with a sizeable fraction of the herd of both politicians and economists charging in the direction of minimalist government, privatisation, and so on." (Stern, 1991a; p.250).

There were substantial reductions in government expenditures in many countries, and because personnel and debt financing costs proved remarkably resilient, the brunt of cuts was borne by infrastructure, health, education and welfare spending. While 24% of Brazil's total government expenditure was allotted to economic services[2] in 1980, only 9.3% was in 1992. In Mexico, the education share of expenditure fell from 18% to 13.9% over the same period, and health from 2.4% to 1.9%. Economic services collapsed from 31.2% to 13.4%. In Pakistan, that share fell from 37.2% to 11.6%, and health and education shares fell as well. Economic services as a share of total expenditure by the Filipino government more than halved from 56.9% to 26.8% (World Bank, 1994).

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[2] Among the expenditure categories used by the IMF Government Finance Statistics Yearbooks and reported in the World Bank's World Development Reports, "economic services" is the one which most closely approximates the general concept of 'infrastructure'.

As policy-makers now ponder the wisdom of building upon these changes, brought about by structural adjustment experiences, with a development strategy more permanently based upon privatization and low levels of public investment, questions have been raised as to the impacts of this on poverty and inequality (see e.g. Cornia, Jolly and Stewart, 1987, and Dreze and Sen, 1989). These concerns with negative impacts of government expenditure reduction on social welfare have often centred around short-term, Keynesian effects on the demand for labour, or on direct effects from changes in cash transfers or subsidies to the poor (see Chapter 2-6 and the WDR 1990).

Nevertheless, as suggested in Chapter 1-4, there are at least another two separate mechanisms through which expenditure reduction can impact upon the poor, and affect the distribution of income more generally. One is an effect on the set of non-marketed entitlements which contributes to current welfare, and the other is an impact on the rates of capital accumulation which will determine future welfare levels. Both can work through the reduction in the free-of-charge provision by the government of inputs into production, such as infrastructure, education, or indeed health care. This chapter investigates how these mechanisms work, by means of a dynamic model which suggests that this reduction may have damaging effects on the long-run distribution of income, even when the inputs are made available equally to rich and poor, and there is no targeting to the worst-off.

To understand the nature of these "public inputs" into private production, it is best to take a broad view of the aggregate production process. The output of private firms depends not only on how much labour and private capital they employ, but also on the quality of the environment in which they operate. Many dimensions of this environment, such as the legal framework; the security services; the quality of public telecommunications; the transport network; the average nutritional and educational quality of the labour force; or the reliability of the power supply are either exclusively or partly supplied by the government. The idea that public capital (and investment) are important determinants of private output (and growth) is therefore both reasonable and familiar (see Stern, 1991b for a discussion and Barro, 1990 for an aggregated model).

While some of the output of the public sector consists of public goods, many others are rivalrous and excludable in their consumption, and can thus also be supplied privately (e.g. education, health services, power generation, telephone services). This paper will

focus on the effects of changes in the public provision of these services, when ability to purchase the private substitutes differs along the distribution of wealth. It addresses theoretically the question of the impact of changes in public investment on the long-run distribution of wealth, and is concerned in particular with the long-run effects of this massive redeployment of productive activity away from the public sector, in an environment of imperfect capital markets.

To do so it draws on the recent literature on wealth distribution dynamics in the presence of capital market imperfections. This was pioneered by Galor and Zeira (1993)[3] and Banerjee and Newman (1991). Other prominent contributions were made by Aghion and Bolton (1993), Banerjee and Newman (1993) and Piketty (1992); a survey of the incipient literature was carried out by Aghion and Bolton (1992).[4] These works suggest plausible specific causes for the persistence of wealth inequality, even in the absence of talent or skill differences. All of these causes are capital market failures. They establish the existence of (unique or multiple) steady state *distributions*, and generally derive interventionist policy implications. Usually it is the case that "by redistributing wealth towards the poor or the middle-class borrowers the government can improve productive efficiency." (Aghion and Bolton, 1993, p.34). But this purely redistributive activity is a remarkably simplistic view of the role of the government in development. This chapter suggests that more traditional activities, such as the provision of infrastructure, health and education, may also help to reduce long-run inequality, in addition to the well known microeconomic efficiency arguments for them, based on externalities and transaction costs.

The government portrayed in other papers in this literature is not involved in any productive activity. Its only policy option is to transfer wealth from rich to poor agents, and even though this is supposed to be a permanent policy, no incentive effects on rational recipients are considered. This picture of the government is naturally oversimplified, and at odds with most current views on the role of the state in the process of development, which encompass active participation in the production of certain goods and services in which, for some reason, it has a comparative advantage. These include at

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[3] A widely cited mimeo version dates to 1988.

[4] A more detailed discussion of this literature and of how it bears on the present model is the subject of § 2.

least the provision of some infrastructural services, education and health, besides pure public goods. The reasons why the government may have a social cost-benefit advantage in the supply of these particular commodities has to do with the relative importance of market failures (eg. externalities; natural monopolies) vis-a-vis government failures (eg. rent-seeking) in their markets. But they have been well studied elsewhere (see Stern, 1991a, and his references) and need not concern us here.

In this paper, the active role of the government arises from the existence of a public capital input into production (g), which is complementary to private capital (k). This g is efficiently produced by the government and distributed free of charge, in identical amounts, to every household-firm in the economy. The quantity each receives at any time t is g_g. Households can also purchase g privately through markets, albeit at a high fixed cost. The amount bought in this way is denoted g_p for that household, and the fixed cost is $\tilde{g}_p$. Allowing for this private alternative to the supply of some public services reflects a very real recent tendency in many developing countries, particularly in Latin America. As The Economist has reported: "In Montevideo and Mexico City, businessmen fed up with inefficient public telephones have embraced cellular technology. In Buenos Aires and Caracas, private courier systems compete vigorously with the state-run postal system. In Cartagena and Lima many put their faith not in the national energy system but in private power generators. Across Latin America, consumers and businesses have been turning to private suppliers for services that had long been available only from the state." (The Economist, 1993, p.50).

This model describes the circumstances under which this sort of competition to the public sector arises, and who its customers are. It also shows why a replacement of state provisions by private ones may increase inequality and reduce output. It explains why "the result generally hits the poor hardest" (The Economist, 1993, p.50). Just as some agents are too poor to be given credit to invest in private capital, others turn out to be sufficiently wealthy to invest in private capital, but still unable to buy public capital.

The remainder of this introduction summarises the basic story. Section 2 discusses some of the related literature. Section 3 presents the model; Section 4 describes the static equilibrium; Section 5 discusses the dynamics of the system and derives the steady-state distribution, and Section 6 performs some comparative static exercises on it. Section 7 concludes.

1.1. The Basic Story:

The model described in section 3 shows how reductions in the level of public investment can lead to an increase in inequality, because the poor are more dependent on the government than the rich. It assumes a large population of risk-neutral households, identical in every respect except their initial wealth. These households are also production units, and their size is normalised to one. No pooling of households is allowed. Each household maximises a utility function (of consumption and bequests), and may choose between a risky (entrepreneurial) production function and a deterministic subsistence one.

Expected returns on the entrepreneurial production function are high enough that everyone would prefer to invest in it if they could. But to do so they must purchase private capital, and there is a fixed start up cost, without which it is impossible to produce. Capital markets do exist, but are imperfect: banks require collateral, on which the maximum size of any loan depends. This means that the poorest households are unable to gather the minimum amount required to invest in the risky production function. They become subsistence farmers and artisans. Richer people, who can buy enough private capital to start up, find their probability of success depending on the amount of public capital (infrastructure, health care, education services) available to them.

Public capital is partly provided by the government, free of charge, in identical amounts to all household-firms. But it is also available from markets, at a price and subject to another fixed start up cost. The middle-class finds that, whilst it can afford to buy private capital, its collateral is not large enough to buy both the minimum outlays of private capital and of private infrastructure. They are hence constrained to operate with the amount of infrastructure made available by the government, whilst their richer competitors can top it up with private power generators, private health insurance, private schooling, etc. The richest households therefore choose an optimal combination of both types of capital, and are able to allocate their investments more efficiently than the credit constrained middle-classes. As a result, they face a higher ex-ante expected rate of return.

The model is set up so that the transition process of wealth across generations is a linear Markov process, which means that no matter what the initial distribution of wealth was like, it will converge to a unique, invariant distribution in the steady state. Furthermore,

for a plausible set of parameter values, all of the three classes described above will exist in that distribution. Increases in government investment will reduce the inequality of opportunity between the richer and the poorer entrepreneurs in that distribution, by reducing the disadvantage to the poorer ones from being unable to buy private infrastructure. It will bring the mix of inputs with which they operate closer to the optimal mix, and thus closer to the one employed by their richer counterparts.

Because this is an open economy, with an integrated capital market, there is an exogenous world interest rate. The capital account is equilibrated by net lending to or net borrowing from abroad, as required. But this exogenous interest rate means that, for very low levels of government investment, the credit-constrained entrepreneurs will face expected returns from investing at home which are so low, that they will prefer to lend all of their wealth in the open market. Hence, there will be a threshold level of public investment below which the middle-class disappears, and domestic investment becomes the exclusive preserve of the very rich, who can buy enough private infrastructure to make it worthwhile operating in the country. Increases in public investment from below that threshold have the additional effect of increasing the number of domestic entrepreneurs, by making it worthwhile for increasingly poorer people to invest at home.

2) A Survey of the Literature.

This section reviews the recent literature on wealth distribution dynamics in the presence of capital market imperfections, following a thematic approach. Below, I comment briefly on two features which are common to all of the models in the literature: the causal role of capital market imperfections and the absence of steady state output growth. I also comment on some features which differ across the models, principally: the type of market imperfection and the specific market where it occurs; the investors' attitude to risk; the nature of the production set; the endo or exogeneity of aggregate variables, such as the interest rate and the wage rate; and finally the uniqueness or multiplicity of steady states.

As Galor and Zeira (1993) pointed out, one way of obtaining a long run persistence of income inequality is to assume that some people are more talented, or able, than others. In the simplest possible scenario, if capital markets are perfect and production sets are convex, returns would be proportional to ability, and lifetime incomes would differ across

individuals. Whether lineages would have different discounted incomes would depend on whether ability is serially correlated or iid across generations. But virtually all contributions to this literature have chosen to assume that agents are identical in abilities and tastes, and differ only in inherited wealth. In this case, capital market imperfections are necessary to obtain long run persistent wealth inequality. Piketty (1992) has shown that in the first best case, with no capital market imperfection of any sort (in his model, this meant effort supply was verifiable) and a convex production set, any initial wealth distribution converged to a degenerate distribution.

What has differed across the various papers has been the specific nature of the capital market imperfection. In general, two classes can be identified: those where the incompleteness of contracts leads to moral hazard in repayment, and those where it leads to moral hazard in effort supply. The former class comprises Galor and Zeira (1993) and Banerjee and Newman (1993). Galor and Zeira have the lender incur some monitoring cost z, which then creates a cost of evasion for the borrower of βz, $\beta > 1$. An incentive compatibility constraint on the borrower ($d(1+i) = \beta z$) and a zero profit condition on the lender ($di = dr + z$) ensure that the borrowing interest rate i exceed the lending rate r.[5] This and the existence of a non-convexity in the accumulation of human capital (a fixed cost h) ensure that only those agents receiving a bequest above a certain level f (i, r, h, ...) will choose to invest in acquiring the human capital (skill) required for participation in the 'advanced' sector. The limiting distributions depend on the initial distribution and on the parameter values, but some cases can be shown to yield a two spike distribution. Poor people stay poor because they are forced to borrow at high interest rates to acquire skills. It is therefore in their best interest to lend their little wealth and work at a (low) unskilled wage instead. Rich people stay rich as their investments generate greater wealth, leading to greater bequests, leading to lower borrowing at high rates, and so on.[6]

Banerjee and Newman (1993), on the other hand, have a collateral requirement rather than a higher borrowing rate keeping the poorest away from credit. This stems from the same

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[5] d denotes the size of the loan.

[6] Not all people who initially invest in human capital see their lineages converge to the 'rich' equilibrium. The cut-off wealth level g exceeds f in the example that generates two spikes.

moral hazard in repayment problem: loan contracts are not costlessly enforceable. But whereas Galor and Zeira have a price adjustment ensuring that the borrower's incentive compatibility constraint holds (i adjusts), this model has a fixed interest rate $\hat{r}$. In a loan (L) market where default is costless, but may be detected with probability π, in which case a penalty F is imposed, and where all borrowers must leave their full wealth (w) as collateral, the incentive compatibility constraint is $(w - L)\hat{r} \geq -\pi F$, i.e $L \leq w + \pi F/\hat{r}$. This is to say that no agent will be granted credit in excess of their collateral, augmented by the expected discounted penalty they would incur if caught defaulting. This quantity adjustment mechanism is borrowed in the model to be presented in section 3, and will be derived more extensively there. The upshot is similar to that in Galor and Zeira: the poorest individuals in society are barred from access to capital markets. Then there is a middle class of borrowers, followed by an upper class of agents whose wealth is sufficient to finance their own projects and to lend. Note that this lending in the upper tail is a consequence of an extreme non-convexity of production: projects are of a strictly fixed size. I return to the implications of this common assumption below.

The other class of models is based on moral hazard in effort supply. The simplest case of this is that of a continuum of risk averse agents who wish to diversify their risk by issuing shares in their own projects and purchasing shares in other people's. With correlated risk assumed away, this is the heart of Banerjee and Newman (1991). But if there is an effort cost e, the marginal disutility of which increases with wealth, complete insurance in the stock market is not an incentive compatible option, as no effort will be supplied by each agent, since the return to it would accrue to other shareholders. The contract incompleteness arises from the non-enforceability of effort, and requires a share $\beta(w)$ of the project to be held by the entrepreneur. Because leisure is normal, β is always increasing in w[7], and so there exists some critical wealth level above which the incentive compatible share of risk to be borne by the entrepreneur is so high that the utility of investing in the project is less than that of lending at the lower but safe rate of interest. Clearly, risk aversion is a pre-requisite for this story. The upshot is an ergodic distribution which may well (or not) include a class of pure rentiers, and must include a class of entrepreneurs, all of which have access to credit and are actively investing. In fact, the poorest agents borrow the most and put in the most effort. Their wealth tends to grow

[7] $\beta'(w) > 0$ throughout.

over generations, until they become rentiers, and it starts declining again. All lineages experience every wealth level over the infinite horizon, with positive probability. For the result that the poorest do borrow and invest, it is crucial that the utility of bequests is unbounded below, and that the market for loans is perfect.

Aghion and Bolton (1993) and Piketty (1992) also belong to this class of models. The former have the moral hazard of effort supply embodied in the probability of project success monotonically increasing with wealth. The rationale presented for this is that the larger the loan, the greater the share of the return which the entrepreneur must divide with his creditors, and hence the lower the incentives to put effort in. Although agents are risk-neutral in this model, this debt overhang performs a very similar role to Banerjee and Newman's (1991) risk sharing effect on effort: by lowering the share of the return accruing to the effort supplier, they reduce the credible effort levels and hence prevent some agents from obtaining any credit. The difference is that whereas Banerjee and Newman's 'effort as an inferior good' means the rich are insurance constrained, Aghion and Bolton's debt overhang is greatest for those who have to borrow most, i.e. the poor. There is therefore a minimum (positive) level of wealth below which all agents are credit constrained.[8]

Piketty, like Banerjee and Newman (1991), has risk averse agents seeking insurance against project risk and non-contractible effort supply. Unlike them, utility from bequests is bounded below. By introducing a 'limited liability' constraint, which is also used by Aghion and Bolton (1993) and which essentially rules out negative consumptions or bequests, he effectively prevents the poorest agents from being able to credibly commit to exert the effort level required for them to qualify to receive loans. Because Piketty innovates by having the first instance in this literature of a fully convex production set, it is no longer a question of investing or not, but of project size. We now turn to this issue.

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[8] These agents may, however, not in fact want to borrow. Regardless, the crucial point is that there is a continuum of poor agents with mass greater than zero which does not borrow to invest, and whose income comes from a subsistence activity and from lending their wealth at the riskless interest rate. The modelling reason for the introduction of this subsistence activity is to avoid collapse of the entire distribution to zero wealth with probability one over the infinite horizon.

In all of the papers cited so far, with the exception of Piketty (1992), there is a most severe production non-convexity. Furthermore, this is of essentially the same form: projects are of a unique size: human capital costs h to acquire in Galor and Zeira, and there is only that fixed level of skill to be had; in both papers by Banerjee and Newman the investment project is of fixed size I[9]; and in Aghion and Bolton the fixed capital used in each project is normalised to 1[10]. It is intuitively easy to understand why these non-convexities, unusual in most conventional production functions, are so common here: most capital market failures result in the poor being denied access to - or choosing to abstain from - borrowing. If their wealth levels are insufficient and they have no access to credit, a minimum capital outlay guarantees they will not be able to invest. Since the expected return on the investment project is assumed higher than the riskless return (otherwise no one would invest), this leads to inequality of opportunity. The investment opportunities faced by agents with different levels of wealth may be different. In the simplest of cases (Galor and Zeira), this leads to a non-ergodic two spike distribution, where the poor are always poor, and the rich always rich. The ergodic distributions derived by Aghion and Bolton, and Banerjee and Newman follow from the stochastic nature of returns to entrepreneurs. Their expected return is higher than the riskless return, but a fixed proportion of them will be unlucky at every period, thus bequeathing less than they received. This stochasticity provides the key mechanism for downward social mobility.

What about upward social mobility? If the poor are constrained to be lenders at the riskless rate, how can they ever make it up to the wealth ranges where they will be able to borrow and invest in high yield returns? Well, they would not unless some other assumptions were brought in to prevent poverty traps similar to Galor and Zeira's. In Aghion and Bolton (as well as in the model in section 3) this is done by allocating these idle lenders a sufficiently high return n to a 'subsistence activity'. In Banerjee and Newman (1991), they are allowed to borrow any amount at the lowest wealth, because

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[9]Banerjee and Newman (1993) introduce a monitoring technology which allows for some entrepreneurs to hire workers. Although this leads to different scales of production, the monitoring technology is linear and discrete, and there still is no convex subset of the production set.

[10] That is presented as a minimum capital outlay, but the marginal product of capital above k=1 is zero.

utility is unbounded below, and hence effort commitments are credible.[11] In Banerjee and Newman (1993), it is by working for the richer entrepreneurs and earning wages that they accumulate sufficient wealth to make the transition to entrepreneurs, if the wage is high enough. For wages below a critical level, there will exist a poverty trap analogous to that in Galor and Zeira, even though the specific mechanisms which determine them are distinct.

As we can see, the production non-convexities play an important role in most of these stories. Piketty derives an ergodic distribution by replacing the unbounded below utility of bequests of Banerjee and Newman, or the wages or subsistence payments to those unable to invest, and allowing for a perfectly convex production set. The intuitive flavour of this story is one of credit constrained small business people crawling out of poverty over countless generations by bequeathing their offspring progressively larger wealth levels than they themselves started with. Upward mobility follows from successful projects leading to larger bequests. The wealth distribution is bounded above because of the normality of leisure: although the problem for poor people is that they can not commit to exert their optimal effort level, the rich put in less and less effort as their wealth increases. After a certain point, the bequests of successful agents are no longer greater than the level with which they themselves started.

Downward mobility follows from failed projects. The lower bound of the wealth distribution is zero, and poverty traps are impossible because of the convexity of the production set. No exogenous payments are needed to prevent them. People work for themselves, dragging themselves out of poverty by their intergenerational bootstraps, so to speak...

I now turn to the related issues of endogeneity of aggregate variables and the uniqueness of the invariant steady state distribution. The models can again be divided into two groups: those with a unique invariant steady state distribution (Banerjee and Newman, 1991; Aghion and Bolton, 1993) and those with multiple steady states, characterised by permanent hysteresis, i.e: the final outcome depends on the initial conditions. These

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[11] Recall that here there is no loan market failure. It is an insurance moral hazard problem to the rich that drives the model.

include Galor and Zeira (1993), Banerjee and Newman (1993) and Piketty (1992). It turns out that all of these have an endogenously determined aggregate variable: w_s for Galor and Zeira, the wage rate for Banerjee and Newman (1993) and the interest rate for Piketty. Conversely, Banerjee and Newman (1991) have no endogenous aggregate variable, and hence a unique ergodic distribution. Aghion and Bolton have an endogenous interest rate, and derive a unique long run distribution, but this depends crucially on a parametric assumption which imposes a lower bound on the rate of capital accumulation (A3). If this is violated, as they point out, uniqueness would no longer attain. Formally, this is because endogeneity of aggregate variables which influence the transition rule for wealth may destroy the stationarity of the Markov process. Non-linearity in turn entails that uniqueness (along with global stability and other such nice properties) is not guaranteed. In general there will be hysteresis: by affecting the wage or interest rate, initial distributions generate different transition rules, and may converge to different steady states.

Whether the steady state distributions are unique or multiple, they are always invariant. In other words, the continuing intra-distributional mobility does not affect the density at any point on the support of the distribution. It follows rather directly from this observation, that this is not a literature about long term growth and distribution. Growth takes place only (and even then, not necessarily) in the transition to the steady state. Once the distribution converges to one ergodic distribution, there is no growth in per capita income. In fact, in the cases where there is a unique steady state distribution, it is clear that convergence to it will take place from initial distributions with a greater, as well as a smaller, mean. From a situation where economic dynamics paid no attention to intra-distributional mobility, and all that seemed to matter was growth of the mean, we seem to have reverted to the other extreme: all long run movement is around a stationary mean, which never grows. If we looked only at the mean, this would be no different from Solow (1956), except for the fact that he at least had population growth.

It is, of course, not surprising that there is no long run per capita growth in these stories: there is no technical progress, endogenous or exogenous. There is no population growth and, as with any steady state, the capital -output ratio must eventually converge to a constant, so that - unless the marginal product of capital is constant as a function of output - capital accumulation must also cease at the steady state.

This section has focused on some of the central features of the recent literature on imperfect capital markets and wealth distribution dynamics. Which of these are most desirable, and which can be improved upon? I believe that the reliance on (capital) market failures to explain persistent inequality is a positive feature. Biologists and psychologists will probably suggest that there is evidence that the distribution of talents is non-degenerate. Nevertheless, in so far as credit markets are imperfect, it is important to highlight the implications of these imperfections for equality of opportunity and, indeed, for efficiency. The empirical implication would be that, while some of the observed inequality is due to heterogeneous abilities, some is due to market failures, and that there are various grounds for intervention to reduce it.

The inexistence of steady-state growth seems to be an undesirable property of these models. Long run growth in per capita output is now a well established stylized fact of development economics (see Reynolds, 1983; Chenery et al, 1986) and any theory which purports to call itself a theory of growth must deal with it. The obvious first step would seem to be to combine some of the insights of the endogenous (aggregated) growth theory with the distributional insights of this literature. This chapter and Chapter 5 attempt to make a small inroad in that direction, in the specific context of the role of public investment.

As regards the type of market failure, I find the diversity a positive feature of the literature. It is intrinsically interesting that risk averse agents with unbounded utility functions below and normal leisure will have the rich being credit constrained (Banerjee and Newman, 1991), whereas a similar effort moral hazard with a limited liability constraint will lead the poor to have no access to credit (Piketty, 1992). If instead agents are risk neutral, it is not in the insurance market that we must look for causes for inequality, but in the market for loans. And that these may work through a higher cost of borrowing (Galor and Zeira, 1993), or through a credit ceiling on poor borrowers (Banerjee and Newman, 1993). Or that even if repayment is enforceable and agents are risk neutral, debt-overhang may lead to a moral hazard of effort problem, credit constraining the poor (Aghion and Bolton, 1993). Personally, I find that the greatest empirical contribution can be made by models that result in the poor being credit constrained, even if they are risk neutral. This suggests a loan market failure, which could be either due to repayment moral hazard, as in Banerjee and Newman (1993), or to effort

moral hazard, as in Aghion and Bolton. I believe that it is an interesting but unresolved empirical issue, which of the two varieties are most important in determining credit constraints. Therefore, on grounds mostly of simplicity, I will adopt the Banerjee and Newman formulation in section 3.

Let us now consider the specific issue of the interest rate. Aghion and Bolton have an endogenous interest rate, in which they were followed by Piketty. This endogeneity allows for this important aggregate variable to be 'explained' within the model, and in addition opens up a wealth of realistic possibilities in terms of multiple steady states. Countries have widely different income distributions, and my own prejudice is that it would be very surprising if at least some of the differences were not due to 'history', or initial conditions. Nevertheless, there are sometimes good theoretical reasons to keep a variable exogenous, even when it is quite possible to endogenise it. An endogenous interest rate determined by equating domestic supply to domestic demand for credit inherently implies a closed economy. In the context of developing economies with access to the international capital markets, the world interest rate, which is effectively exogenous from their individual viewpoint (the small country assumption being justified in the market for capital) is a very important variable. If we treat the riskless interest rate as endogenous, we are no longer able to make predictions about foreign direct investment, capital flight, or any other form of capital flow. I believe that, for this reason, it is justifiable to keep the interest rate exogenous in the analysis in section 3. As a result, the steady state distribution is unique. This would no longer necessarily remain the case, however, if a labour market were introduced along the lines of Banerjee and Newman (1993). An endogenous wage rate might well then give rise to hysteresis. Whilst this would add to realism, the model is complex enough as it is, because of the two different technologies, and I leave a labour market out of the analysis on grounds of simplicity.

Finally, what about the convexity of production sets? Remarkable though Piketty's modelling achievement is, the fact remains that most production activities do have some fixed cost or indivisible initial outlay. Land in agriculture, a plant in manufacturing, a year's fee in schooling, even the costs of some minimum inventories in informal sector trading, are all examples of fixed initial outlays in production. More problematic is the assumption that all production takes place in a unique fixed scale. What is unrealistic is not that a minimum outlay is required for access to production. It is that beyond that level,

people can not have larger projects, or indeed, replicate the existing one. Aghion and Bolton's contention that their technology is simply an extreme version of a U-shaped cost curve does not answer this point, because a richer agent in their model can not replicate the plant next door. The fixed size is a maximum amount of entrepreneurial production that may be undertaken.

This I find an unrealistic property, and one with serious consequences: the rich will lend rather than invest more, reducing the scope for augmenting inequality. In the model in the next section, therefore, I combine a minimum investment size with a convex production subset for any scale larger than that size.

Before turning to that model, it should be mentioned that the three theoretical chapters in this thesis, in common with the literature discussed above, do not consider political interactions between agents. Governments are assumed to be of the benevolent dictator variety, and there is no voting or any other political economic behaviour by individual agents. The very interesting issues which arise when policies are the outcomes of an explicit political process have been the subject of a related literature, of which Persson and Tabellini (1994) and Alesina and Rodrik (1994) are important examples. These papers also derive results which link greater inequality with a decrease in efficiency, although in different ways. They consider growth explicitly and, in general terms, inequality leads to less growth because it causes the voting process to approve more redistributive policies, which create disincentives to effort. Glomm and Ravikumar (1992) use such a voting model to analyze an issue closely related to the subject of this chapter, namely a comparison of public and private schooling regimes, in terms of both growth and inequality. They also find that public education leads to less inequality, but in their model private education will generally bring faster growth. One important reason for that is the impossibility of topping up: the two regimes are seen as pure substitutes, and the complementarity between public and private inputs allowed below is not permitted in their model. While the political economy analysis of distribution and growth is a flourishing an interesting area, which has generated insights complementary to those of the imperfect capital markets literature, there is no room to survey it here. I now turn to the model.

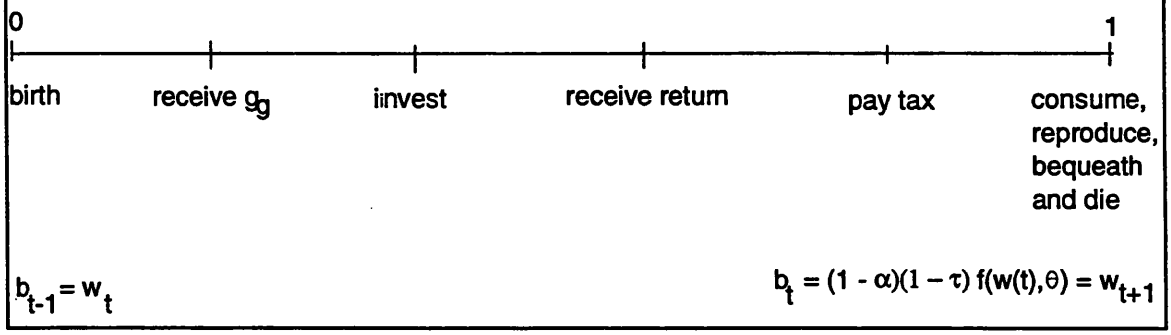
3) A Model of Wealth Dynamics yielding Different Degrees of Dependence on Government Investment.

I assume a continuum of risk-neutral agents with wealth distributed in [0, w_f] with total mass one[12]. At any time t, their distribution function is denoted by $G_t(w)$, which gives the measure of the population with wealth less than w. All projects are conducted by identical households of normalised size 1. Agents live for one period and have one child each. They seek to maximise:

$$U(c,b,e) = hc^{\alpha}b^{1-\alpha} - e \qquad (1)$$

where $0<\alpha<1$. c denotes the agent's total consumption, b denotes his bequest and $e \in (0,1)$ is his effort level in production. This formulation implies the "warm glow" bequest motive (see Andreoni, 1989), as well as that leisure is additively separable from consumption and bequests. There is one good, which can be consumed or invested, and if invested can be invested in private and/or public capital. The timing of an agent's life is represented in Figure 1.

Figure 1



Domestic production takes place according to the following production function:

[12] w_f is very, very large.

$$\Omega(k_t, g_t, e_t) = 0 \qquad if \quad e < 1 \tag{2}$$

$$\Omega(k_t, g_t, 1) = \Phi(k_t, g_t) \tag{3}$$

where k denotes the level of private capital used in production. This formulation requires an inelastic labour supply, as output is zero unless full effort is exerted. Furthermore, even if e = 1, there is a fixed start-up amount of k (= $\bar{k}$) which is required for production to take place. If both these conditions are satisfied, returns are given by the stochastic production function below:

$$\Phi(k_t, g_t) = 0 \qquad with\ prob\ 1 \qquad if\ k_t < \bar{k} \tag{4}$$

$$\begin{aligned} \Phi(k_t, g_t) &= \hat{r} k_t \qquad with\ prob\ q \mid k_t \geq \bar{k} \\ &= 0 \qquad with\ prob\ 1-q \mid k_t \geq \bar{k} \end{aligned} \tag{5}$$

$$where \quad q = v^{-1}(g/k) \qquad v' > 0 \tag{6}$$

Here, v(.) is defined over the domain [0,1], with v(.) = ∞ for any q $\notin$ [0,1]. For example:

$$g/k = q^{1/a} \qquad 0 < a < 1 \tag{7}$$

Then,

$$E[\Phi(k_t, g_t) \mid k_t \geq \bar{k}] = \hat{r} q k = \hat{r} k^{1-a} g^a \tag{8}$$

Now, let $g_t = g_{gt} + g_{pt}$, where the g subscript denotes the per capita stock of public capital provided by the government at time t, and the subscript p denotes the amount of public capital purchased privately by the agent in question at time t. The government's budget constraint is given by:

$$g_{gt} \int_0^{\infty} dG(w) = T_{t-1} + X_t \qquad (9)$$

where T_t denotes the domestic tax revenue in period t, and X_t is the value of net transfers from abroad in period t, which is given exogenously. I assume that these transfers are made to the government, which invests the receipts in a socially efficient way in public capital, g.

The issue of optimal government policy in a dynamic framework such as this, with an explicit distribution of income, imperfect capital markets, and a public capital input into private production, is both complex and potentially rich. This chapter does not pursue that issue, assuming instead that the government is constrained to raising its domestic revenue by means of a constant proportional income tax, and to spending it entirely in the production of g_g, which it then distributes uniformly and free-of-charge to all private citizens. Hence:

$$T_t = \tau \int_0^{\infty} f(w_t, \theta_t)\, dG_t(w) \qquad (10)$$

where f(.) is defined in equation (33) below and denotes the income accruing to any individual with wealth w and random drawing θ in time t. The optimal choice of tax rate τ depends not only on the government objective function, but also on the transfers X, on the country's total GNP, on technological parameter a and - crucially - on the distribution function G(w). The next chapter provides a demonstration that, for most plausible GNP values and distributions G(w), the choice of τ that maximizes GNP at steady-state is positive. It also investigates some interesting properties of that optimal τ^*, and discusses some more general taxation and expenditure policies open to (a less administratively constrained) government.

In this chapter, however, I assume that τ is fixed at some historically given level, and any changes in public investment are brought about by changes in the exogenous level of foreign transfers X. As the next chapter demonstrates, the optimal τ would generally change in response to any change in transfers, but this issue is treated there and the above

assumption greatly simplifies the analysis in this chapter. Furthermore, since the large reductions in public investment which were observed in the 1980s were generally precipitated by comparable cuts in net transfers from abroad, it is not merely a simplifying assumption. In the context of structural adjustment policies, when the pressures forcing governments to slash investment were the twin deficits of the budget and the balance of payments - both of which were exacerbated by large cuts in foreign transfers - and when tax policies were in a first instance frozen, this assumption is quite appropriate. Long term aggregate net transfers[13] to all developing countries fell from U$46.5 billion in 1981 to U$11.5 billion in 1991, with the figures for each year between 1984 and 1988 actually negative. Transfers to the severely indebted middle income countries fell from U$9.0 billion in 1981 to -U$11.0 billion in 1990, whereas severely indebted low income countries suffered a decline from U$6.6 billion in 1981 to -U$0.9 billion in 1990 (World Bank, 1991). This assumption is true to the spirit of expenditure reduction in the 1980s, when "debt crises and budget crunches ... led many governments to neglect their infrastructure." (The Economist, 1993, p.50).

Three other assumptions complete the description of the production side of the economy. There is a fixed cost of purchasing public capital privately (A1), so that:

$$g_{pt} \in [\bar{g}_p, \infty) \qquad \bar{g}_p > 0 \qquad (11)$$

and there is an exogenously given riskless world interest rate r, such that $1 < r < \hat{r}a^{a}(1-a)^{1-a}$ (A2)[14]. Finally, a 'subsistence technology' is also available to all agents, and is given by

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[13] Long term aggregate net transfers are defined by the World Debt Tables of the World Bank as the sum of net resource flows on long term debt (excluding IMF) plus official grants (excluding technical assistance) and net direct foreign investment, minus interest payments on long term loans and foreign direct investment profits.

[14] This may be seen as a 'domestic viability condition' on $\hat{r}$, given the world interest rate and the domestic technological parameter a. The second inequality imposes a lower bound on $\hat{r}$, above which domestic investment is always profitable, provided k and g are combined in their optimal proportions. The optimal k/g ratio - (1-a)/a -equates the marginal revenue products (MRPs) of k and g. Substituting the ratio into the expression for either MRP, and requiring that it be greater than r, gives A2.

$s(e) = 0$ for $e < 1$, $s(1) = n$. (A3)[15]

Four comments about this production structure may be appropriate at this stage. First, effort is an argument simply to acknowledge that there is a labour input, and to be explicit that there is no moral hazard problem associated with its supply, which is perfectly inelastic at 1. Both the main and the subsistence technologies only yield positive returns if $e = 1$. Note also that this specification rules out any labour pooling. Firms have a fixed employment level of 1, and may vary only their capital input.

Second, there are two sources of non-convexity in the production set. These arise from $\bar{k}$ and $\bar{g}_p$, which are minimum requirements for capital purchases. In particular, no production can take place with $k < \bar{k}$, and no private purchases of public capital can be smaller than $\bar{g}_p$. To rule out the trivial cases, let $\bar{k}$, $\bar{g}_p > \pi F/r$, where π and F are defined below.

Third, the complementarity between k and g comes from increases in g increasing the probability of success - and hence the expected value - of a project employing k. This suggests a world where observed returns to private investment are directly proportional to the amounts of private capital purchased, and not to the quality of roads or telephone systems, but where better roads and more reliable telephones increase the chances of the project being viable. Think of a farmer taking produce to the market. He owns a lorry (k), which he drives on a road (g). His returns depend on how many vegetables he can fit in the lorry, but the quality of the road determines the probability that he will make it to the market at all. Furthermore, no road ($g = 0$; $q = 0$) means no project: he would have to eat his produce by himself. Clearly, to build his own, private road, he would need a large fixed amount ($\bar{g}_p$).

Finally, notice that g is **not** a public good. In fact, its consumption must be rivalrous and

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[15] n and $\hat{r}$ are such that:

$$(\frac{1}{1-\alpha} - r)(\bar{k} - \frac{\pi F}{r}) < n < \hat{r}\bar{k}^{1-\alpha}\bar{g}_g^{\alpha} - r\bar{k}$$

The first inequality rules out poverty traps, and the second ensures that the subsistence activity is only chosen by credit constrained people.

excludable. g_g is simply the total government revenues divided up equally amongst all the household-firms. The natural way to interpret g is as an entitlement, made freely available to residents by the state, to any good or service useful in production, which can also be substituted for private alternatives, albeit at a cost. g_g is the right to place a child in a state school, the right to use state hospitals, the right to be connected to public telephones or the power supply, the right to use a public road.

Turning now to the capital markets, I follow Banerjee and Newman (1993) in assuming that, although returns to investment projects are costlessly verifiable, repayment is not costlessly enforceable. Borrowers whose projects fail are forgiven, but successful ones - who must repay - face no cost of defaulting other than a fixed penalty F - unrelated to the size of their loans -which they are forced to pay if they are caught having defaulted. The probability that a defaulter is caught is π. Since all agents are risk-neutral, this means that the market for loans would only lend small amounts (up to $\pi F/r$), unless some institutional arrangement could be developed to increase agent willingness to repay. One obvious such institutional arrangement is a collateral requirement. Loan size is maximised by requiring that an agent's total wealth be left as collateral for any loan. I assume that this is the case in what follows and that lenders pay r on any collateral left with them, upon returning it to the borrower after repayment of the loan. All loans take place at this riskless rate r.

An agent that borrows an amount L, having left his wealth w as collateral will repay it iff:

$$V(L) - \pi F \leq V(L) - rL + rw \qquad (12)$$

where V(L) is the value of the loan to the borrower. It follows directly that individual borrowers face a credit ceiling which is an affine function of their wealth, and which is given by:

$$L_c = w + \pi F/r \qquad (13)$$

4) The Static Equilibrium.

From these simple utility and production functions, and using this design of the capital markets, we can now turn to the static equilibrium of the model. The goal of this section

is to arrive at a description of the payoffs of all agents in any given period of time, depending on their initial wealth levels. To do so, I first identify the thresholds between social classes into which the continuum of wealth levels divides itself (Lemma 1) and the range of public investment levels of interest (Lemmas 2 and 3). I then determine the activities undertaken in each social class (Lemma 1 and propositions 1 and 2).

Lemma 1: $\exists$ w*, w**; $0 < w^* < w^{**}$, such that a) agents with $w < w^*$ are subsistence lenders, and b) agents with $w^* \leq w < w^{**}$ are constrained to using public capital supplied by the government only.

Proof: a) The minimum investment necessary to become an entrepreneur is $\bar{k}$. Agents with $w < \bar{k}$ obviously need to borrow if they are to invest, but they can only borrow up to their credit ceilings. Hence, agents with wealth less than $w^* = \bar{k} - \pi F/r$ will not have access to the start up investment needed to become an entrepreneur. This is an incentive compatibility constraint. Their only alternative is then to dedicate their whole effort supply to the subsistence activity and lend all of their wealth at the riskless rate r.[16]

b) If an agent wishes to complement the stock of public capital made freely available to her by the government (g_g) by purchasing privately supplied public capital, then she must make a minimum outlay of $\bar{g}_p$. But because she must also have bought $\bar{k}$, without which her returns on g_p will be zero with certainty, it follows that agents with wealth less than $w^{**} = \bar{k} + \bar{g}_p - \pi F/r$ will not have access to sufficient funds to purchase private public capital. Since $\bar{g}_p > 0$, $w^{**} > w^*$. ■

The next two lemmas establish the existence of a range of values of government investment in which one observes a coexistence of projects using only g_g with those that use both g_g and g_p.

Lemma 2: $\exists$ $\bar{g}_g$ such that for $g_g < \bar{g}_g$ no pure public capital (supplied by the government) projects are undertaken.

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[16] I rule out the case in which these poorest agents might prefer to forgo earnings from subsistence to enjoy leisure, by assuming that h is large enough so that:

$$hn\alpha^{\alpha}(1-\alpha)^{1-\alpha} > 1$$

Proof: An agent's expected payoff from borrowing to purchase $k \geq \bar{k}$ and $g_p \geq \bar{g}_p$ and undertaking a project is:

$$\Pi := \hat{r}k_t^{1-a}(g_g + g_p)^a - r(k + g_p - w) \tag{14}$$

Hence,

$$\frac{\partial \Pi}{\partial k} = \hat{r}(1-a)k^{-a}(g_g + g_p)^a - r \tag{15}$$

which is decreasing in k and increasing in g. If there were no non-convexities in private capital accumulation (i.e. $\bar{k} = 0$), agents with wealth $w < w^{**}$ would choose k by setting (15) equal to zero, that is: by equating the expected marginal revenue product of capital to the outside option r. But because of the non-convexity, g_g could be so low that:

$$\hat{r}(1-a)\bar{k}^{-a}g_g^{\,a} < r \tag{16}$$

If that is the case, investment will still take place iff:

$$\hat{r}\bar{k}^{1-a}g_g^{\,a} - r(\bar{k} - w) \geq rw \tag{17}$$

or:

$$\hat{r}\bar{k}^{-a}g_g^{\,a} \geq r \tag{18}$$

The equality boundary of (18) determines $\bar{g}_g$, which is thus given by:

$$\bar{g}_g := (r/\hat{r})^{1/a}\bar{k} \tag{19}$$

At lower levels of government supplied public capital, expected returns to domestic private capital investment - in the absence of private purchases of public capital - are lower than those to riskless lending at the international rate (e.g. capital flight). In that case, projects will only be undertaken by agents with wealth greater than $\tilde{w} = \max(w^{**}, w')$. w' is defined by:

$$w' := \bar{k} + g'_p - \frac{\pi F}{r} \tag{20}$$

where g'_p (g_g) is given by[17]:

$$\hat{r}(1-a)\bar{k}^{-a}(g_g+g_p)^a = r \tag{21}$$

■

It follows that if $g_g < \tilde{g}_g$, all observed projects would necessarily use both g_g and g_p. In other words, the middle class disappears, and any entrepreneurs belong to the upper class. Figure 2 below illustrates the determination of $\tilde{g}_g$: the expected marginal revenue product of k is a decreasing function of k, but increasing with g. Its curve thus shifts to the left as g falls. For each level of g, there is one curve for MPk, and one for the expected average product of k (APk), the expression on the LHS of (18). If g were to fall below that for the curves drawn in figure 2, any household constrained to investing only in k would prefer to lend its wealth at the going riskless rate r, rather than facing the lower prospective returns from investing $\bar{k}$ (or more) domestically.

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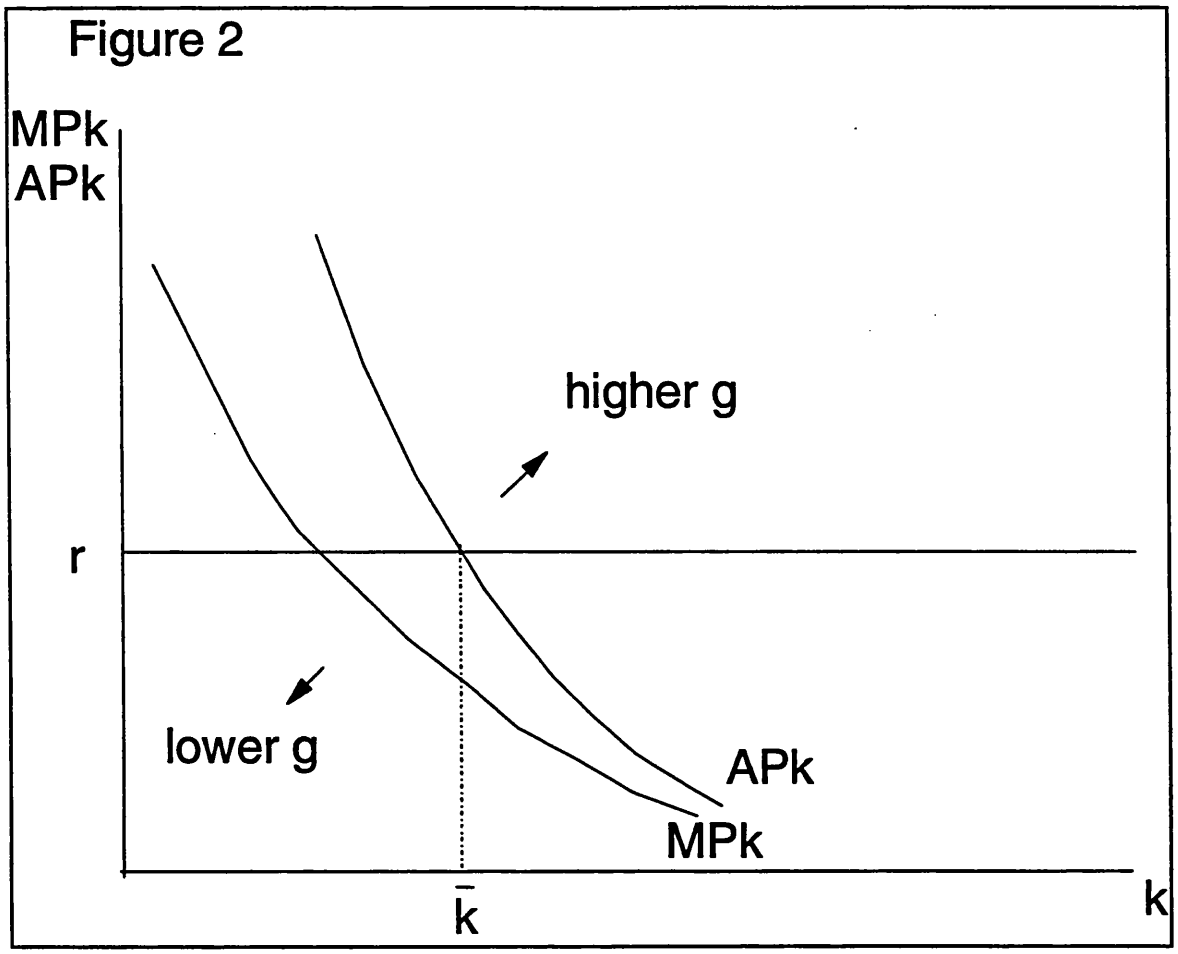
[17] An obvious interpretation of (21) is that it determines the level of g_p necessary to raise the expected marginal product of k (evaluated at $\bar{k}$) to r. Strictly speaking, however, it is an approximation to the true condition:

$$\frac{\hat{r}\bar{k}^{1-a}(g_g+g'_p)^a}{\bar{k}+g'_p} = r$$

The definition and discussion of variable λ, in the proof of proposition 2, establish that the LHS of the above equation tends to the LHS of (21) from above, as $w \to \infty$. g'_p as defined in (21) is clearly sufficient for investment to take place, and the approximation, apart from being intuitive, is more tractable.



Lemma 3: $\exists\ g_g^{\$}$ such that for $g_g > g_g^{\$}$, there is no demand for privately supplied public capital.

Proof: Consider $k_f = w_f + \pi F/r$. $g_g^{\$}$ is given by:

$$\frac{k_f}{g_g} = \frac{1-a}{a} \tag{22}$$

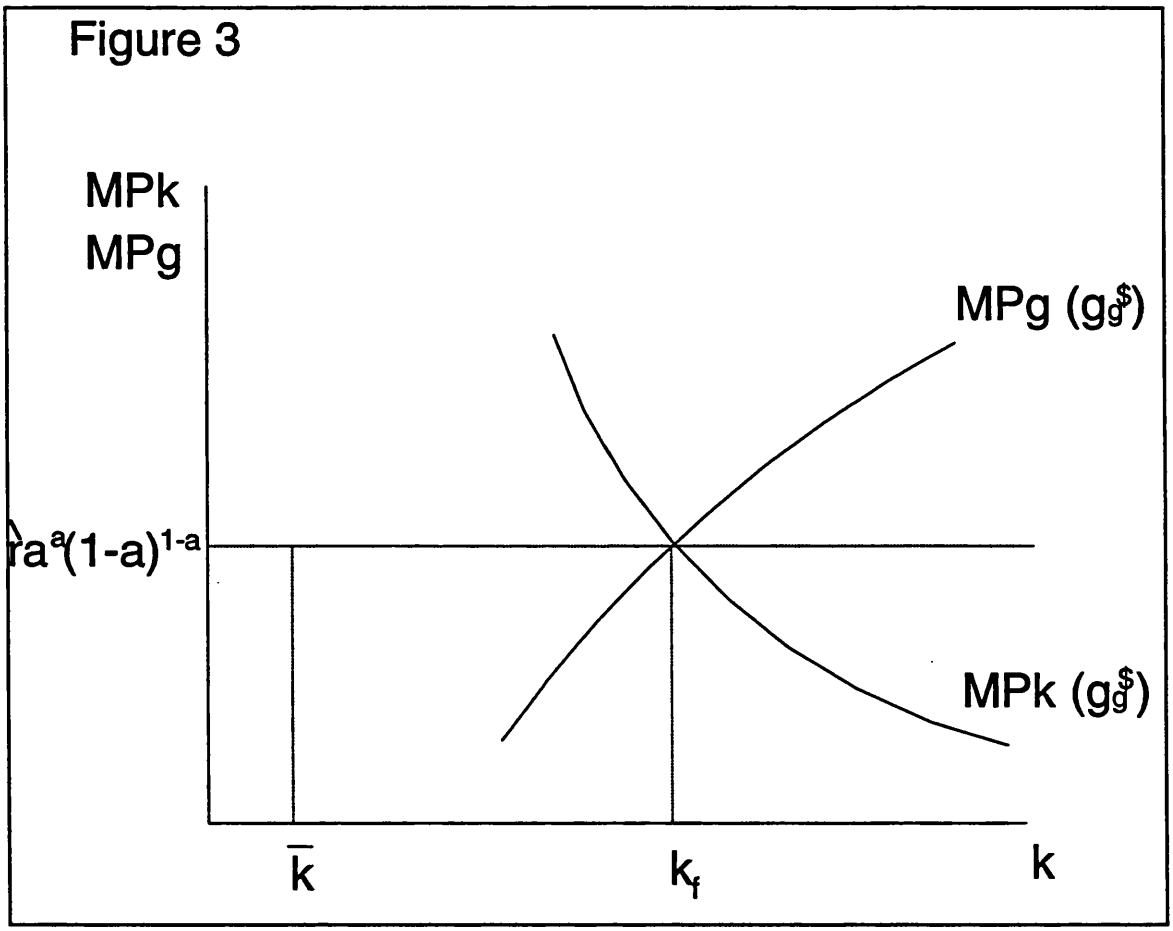
because for $k/g < (1-a)/a$,

$$\frac{\partial \Pi}{\partial k} = \hat{r}(1-a)k^{-a}g^{a} - r > \hat{r}k^{1-a}ag^{a-1} - r = \frac{\partial \Pi}{\partial g} \tag{23}$$

Hence, all private investment would be in private capital until $k = k_f$. But since the richest agent in society has $w = w_f$, then her credit constraint prevents her from borrowing any money to finance purchases of privately supplied public capital. All agents poorer than her would not even be able to reach the optimal private-public capital ratio, and would therefore invest only in k. When $g_g^{\$}$ is supplied by the government, there is therefore no

demand for privately supplied public capital in this society, and all observed projects would use only g_g.■

Figure 3 below illustrates the determination of $g_g^{\$}$. The downward sloping curve denotes MPk, as in figure 2, and the upward sloping one denotes MPg. They always cross along the dotted line, which gives the value of both marginal products when the optimal input ratio is being used. If $g_g = g_g^{\$}$, MPk exceeds MPg for all values of k that can be afforded, even by the richest member of society, so there is never any demand for g_p.



The last two results can be summarized as follows: private and public capital are complementary inputs. Their respective marginal products rise with the quantity of the other input. For very low levels of g, therefore, the marginal product of private capital is so low that it becomes more profitable for capital to leave the country (lent at r) than to be invested domestically. Only the very rich ($w > \tilde{w}$) can afford to buy sufficient amounts of privately supplied public capital to make it worthwhile to invest at home. This is reminiscent of capital externalities of the Arrow (1962) type, and could lead to capital

flows from poorer to richer countries, thus illustrating the expatriation of capital from poor countries with abysmal infrastructures, such as exist in Africa or Eastern Europe.

On the other hand, if g_g is very high, then the returns to investing in privately supplied public capital are lower than those to investing in private capital. The wealth level of the richest agent is not high enough to enable her to obtain a loan large enough to drive k/g_g to the optimal ratio. Therefore, no one has any incentive to invest in g_p.

One might claim that below $\tilde{g}_g$, one is in a poor country where infrastructure, public health and education are so limited that minimum conditions for private investment are lacking, and one observes little incentive to save, capital flight and the existence of a small sector of large modern enterprises which build their own transport and communications network, as well as schools and health centres. In a world above $g_g^{\$}$, on the other hand, one might be in a rich country with an active and efficient government, which provides high quality infrastructure, a reliable health care system and such a good standard of public education that no one ever finds it in their interest to go to the market place for alternative provision of these services. Some European countries, notably in Scandinavia in the 1960s and 1970s, might have approximated this extreme. By and large, however, most countries in the world display a co-existence of government-provided infrastructure, health and education services with privately supplied substitutes. For this reason and because we are interested in the effects of public investment on equity and growth, we limit our attention for the moment to cases where $g_g \in (\tilde{g}_g, g_g^{\$})$. This interval was established by Lemmas 2 and 3 as the range of public investment outlays in which projects relying exclusively on government-provided public capital will coexist with projects employing both g_g and g_p. It also implies that at $w = w^*$, there is demand for k.

We are now able to describe the social structure prevailing in this economy, according to the sort of economic activity undertaken at each wealth level.

Proposition 1: In general, agents with wealth $w \in [w^*, w^{**})$ are either borrowing or lending entrepreneurs. The only form of public capital they use is that supplied by the government.

Proof: As we are considering only cases where $g_g > \tilde{g}_g$, it follows from inequalities (17)

and (18) that any agent with $w = w^* = \bar{k} - \pi F/r$ will borrow to invest. These are the poorest agents in the interval $[w^*, w^{**})$. As we move along the interval to higher wealth levels, there are four possible cases, depending on the exogenous level of g_g:

CASE 1)

$$\hat{r}(1-a)(w^{**} + \frac{\pi F}{r})^{-a} g_g^{\,a} \geq r \qquad (24)$$

In this case, g_g is high enough, so that it is profitable to invest in k for any $w \in [w^*, w^{**})$. All agents in that interval will therefore borrow the full amount to which they are constrained, and invest it.

CASE 2)

$$\hat{r}(1-a)(w^{**} + \frac{\pi F}{r})^{-a} g_g^{\,a} < r < \hat{r}(1-a)(w^{**})^{-a} g_g^{\,a} \qquad (25)$$

This is a marginal case: all agents in the interval invest their full wealth in k, although the richest portion may not borrow all they are able to. No one in the interval lends.

CASE 3)

$$\hat{r}(1-a)(w^{**})^{-a} g_g^{\,a} < r < \hat{r}(1-a)(w^{*} + \frac{\pi F}{r})^{-a} g_g^{\,a} \qquad (26)$$

Then all agents with $w \in (w^*, w_0)$ borrow whatever they are allowed up to $(w_0 - w)$ to invest in k, while the richer people with $w \in (w_0, w^{**})$ invest w_0 in a project and lend $(w - w_0)$ at r. w_0 is given by:

$$\hat{r}(1-a) w_0^{-a} g_g^{\,a} = r \qquad (27)$$

CASE 4)

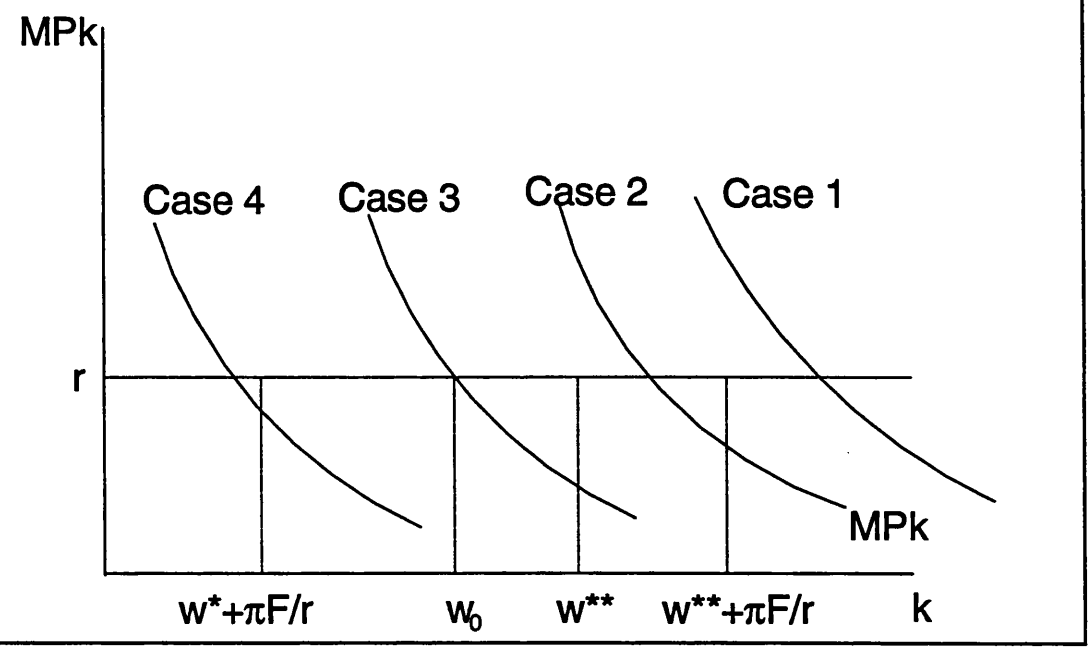
$$\hat{r}(1-a)(w^{*} + \frac{\pi F}{r})^{-a} g_g^{\,a} < r < \hat{r}(w^{*} + \frac{\pi F}{r})^{-a} g_g^{\,a} \qquad (28)$$

In this marginal case, all agents invest exactly $\bar{k}$. Those with $w \in [w^*, w^* + \pi F/r)$ borrow $w^* + \pi F/r - w$ to invest $\bar{k}$. Those with $w \in [w^* + \pi F/r, w^{**})$ invest $\bar{k}$ and lend any remainder at r.

The fact that - in all cases - they use only g_g, and not g_p, follows from part (b) of the proof to Lemma 1. ■

Figure 4 below illustrates the four different cases. In case 1, public investment is large enough to make it profitable for everyone in the middle class interval to invest domestically. Case 2 is a borderline one, but still there are no lenders. In case 3, households richer than w_0 will choose to lend a fraction of their wealth in the international capital market, although they will invest up to w_0 domestically. In case 4, although the marginal product of k (at $\bar{k}$) is less than r, the total expected return from investing $\bar{k}$ exceeds $r\bar{k}$, so that everyone invests exactly that amount. This can be seen as a special version of case 3, arising from the non-convexity of the production set.

Figure 4



Proposition 2: In the relevant range of public investment (i.e. for $g_g \geq \bar{g}_g$), there are no lenders with $w \geq w^{**}$. All agents with $w \in [w^{**}, \infty)$ are entrepreneurs, borrowing up to their credit constraint and investing in k, or k and g_p.

Proof: The expected returns to undertaking a project using technology (8) are a homogeneous of degree one function of both types of capital. It follows that there is an

optimal k/g ratio. Equating the marginal products yields:

$$(\frac{k}{g})_{opt} = \frac{1-a}{a} \tag{29}$$

At that ratio:

$$\frac{\partial \Pi}{\partial k} = \frac{\partial \Pi}{\partial g} = \hat{r}a^{a}(1-a)^{1-a} - r > 0 \tag{30}$$

where the inequality is assumed in (A2).

Define $g_g' := \max (0, a\bar{k}/(1-a) - \bar{g}_p)$, a positive value of which can be interpreted as the level of government capital outlays which would enable an agent with $w = w^{**}$ to reach the optimal k/g ratio. Define $w_s := \bar{g}_p/a + (1-a)g_g/a - \pi F/r$, which should be interpreted as the wealth level at which - using the exogenous g_g and $\bar{g}_p$ - the agent is able to buy enough k to reach the optimal input ratio (see equation (32) below). Also, let $\lambda = k/(k+g_p)$ be the share of the loan used to purchase private capital k. With wealth above w^{**}, two cases can arise, depending again on the exogenous level of g_g and value of $\bar{g}_p$.

CASE 1) $g_g < g_g'$. (Since we are assuming that $g_g \in (\bar{g}_g, g_g^{s})$, this case can only arise if $g_g' > \bar{g}_g$.) This case implies that:

$$\frac{\bar{k}}{g_g + \bar{g}_p} > \frac{1-a}{a} \tag{31}$$

and that $w_s < w^{**}$. $\partial\Pi/\partial k$ and $\partial\Pi/\partial g$ are functions of the ratio (k/g) only, because of the homogeneity property. It is evident that for k/g greater than the optimal, $\partial\Pi/\partial g$ will be greater than the expression in (30) above, whereas $\partial\Pi/\partial k$ will be smaller. So in this case $\partial\Pi/\partial g\ (\bar{k}, g_g + \bar{g}_p) > \hat{r}a^{a}(1-a)^{1-a} > \partial\Pi/\partial k\ \ (\bar{k}, g_g + \bar{g}_p)$. That it is still worthwhile to purchase $\bar{k}$ is assured by the fact that $g_g \geq \bar{g}_g$ (see Lemma 2). Then at w^{**}, $\lambda \leq 1$, as a share of the loan is spent to purchase g_p, so as to bring k/g closer to its optimal value. (Clearly, if it was worth buying $\bar{k}$ when $g_g = \bar{g}_g$, it must be even more so with $g_g = \bar{g}_g + \bar{g}_p$.) As wealth increases, λ eventually tends towards 1-a ($\lim_{w\to\infty}\lambda = 1-a$), while k/g is constant at (1-a)/a.

CASE 2) $g_g \geq g_g'$. This can only make investing more attractive than in case 1. Since in that case all agents with $w > w^{**}$ invested their full wealth domestically, they will also do so in this case. But now, at w^{**} the marginal revenue product of k exceeds that of g (evaluated at the appropriate minimum purchase quantities: $\bar{k}$, $g_g + \bar{g}_p$), so $\lambda = 1$ and $w_s > w^{**}$. The definition of w_s is such that :

$$\frac{w_s - \bar{g}_p + \pi F/r}{g_g + \bar{g}_p} = \frac{1-a}{a} \qquad (32)$$

For $w < w_s$, $\partial\Pi/\partial g\ (k, g_g + \bar{g}_p) < \partial\Pi/\partial k\ (k, g_g + \bar{g}_p)$, so that agents prefer to invest in k.[18] This changes at $w = w_s$, when (32) holds. For $w > w_s$, $\lambda < 1$ and $d\lambda/dw < 0$, with $\lim_{w\to\infty}\lambda = 1\text{-}a$, as in case 1. Also, for $w > w_s$, the k/g ratio is always at its optimal value, given by (29).

Hence, for any of the cases in proposition 2, agents wealthier than w^{**} will borrow up to their credit constraint and invest fully in the domestic project. They will buy $\bar{g}_p$ as soon as it is profitable to do so, which depends on the level of g_g, and keep the optimal k/g ratio from the earliest opportunity. There will be no lenders in this wealth interval. ■

On the basis of lemma 1 and the two foregoing propositions, we can completely describe the pre-tax payoffs of agents as a function of their initial wealth levels. Naturally, these will depend on which case of proposition 1 happens to hold (which essentially depends on the exogenous g_g). The flavour in all cases is similar, however, and I now limit consideration to case 1, for simplicity:

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[18] The non-convexities can create problems again. A very large $\bar{g}_p$ drives $g'_{\bar{k}}$ down. A situation could arise where, although $\partial\Pi/\partial k > \partial\Pi/\partial g$ when $\bar{g}_p$ is purchased, $rk^{-a}g_g^{\ a} < r$ when it is not purchased. In that case marginal considerations are clearly not a guide to agents' optimal behaviour, and $\bar{g}_p$ will be purchased. That this is better than lending abroad follows from the fact that $\Pi(w) > rw$, $\forall\ w \in [w^{**}, \infty)$ with a lower g_g in case 1, when $\bar{g}_p$ was purchased.

Agents with	receive	with probability
$w \in [0, w^*)$	$n + rw$	1
$w \in [w^*, w^{**})$	$\hat{r}\, w + (\hat{r} - r)\, \pi F/r$	q
	0	1-q
$w \in [w^{**}, \infty)$	$\hat{r}\lambda w + (\hat{r}\, \lambda - r)\, \pi F/r$	q
	0	1-q

These describe the three classes: subsistence workers, middle-class entrepreneurs who must rely on the government for their g, and the unconstrained upper class.

5) The Transitional Dynamics and the Steady State Distribution.

The utility formulation in (1) implies that a fixed fraction $1-\alpha$ of net wealth at life-end is left as a bequest. Therefore we can identify the intergenerational dynamics for each dynasty precisely, in the following manner. If $\theta \in \{0,1\}$ is defined as the random variable that indicates success for a project ($\theta = 1$ with probability q; $\theta = 0$ with probability 1-q)[19], and if it is clear that w_t indicates initial wealth at the beginning of period t, we can write:

$$w_{t+1} = (1 - \alpha)\,(1 - \tau)\, f(w_t, \theta_t) \qquad (33)$$

where, of course, $f(w_t, \theta_t) =$

$$\begin{cases} n + rw_t & \text{if } w_t \in [0, w^*) \\ \theta_t[\hat{r}w_t + (\hat{r} - r)\,\pi F/r] & \text{if } w_t \in [w^*, w^{**}) \\ \theta_t[\lambda_t \hat{r}w_t + (\hat{r}\,\lambda_t - r)\,\pi F/r] & \text{if } w_t \in [w^{**}, \infty). \end{cases}$$

Different values for the parameters will generate different graphs for (33), but the parametric restriction in footnote 15 ensures that at least the two first classes are always

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[19] Since $q_t = v^{-1}(g/k)_t$, θ_t is not i.i.d.. But - because $(g/k)_t$ is a function of the current value w_t alone, and not of w_{t-j}, $\forall\, j \neq 0$ - θ_t is independently distributed over time. The same is true of $\lambda_t = k_t/(k_t + g_{pt})$. This share of the loan used to buy k depends only on w_t and on time-invariant parameters π, F and r, but not on any previous value of w.
This implies that $\Pr(w_{t+1} \in A \,/\, w_t, w_{t-1}, \ldots, w_0) = \Pr(w_{t+1} \in A \,/\, w_t)$, which allows us to define the Markov process of the wealth variable in the unidimensional state space W, as in the proof of proposition 3 below.

present. If parameter values are such that, in addition:

$$w^{**} < \bar{w} := \frac{1-\alpha}{1-\hat{r}\lambda(1-\alpha)(1-\tau)}(\hat{r}\lambda - r)\frac{\pi F}{r} \qquad (34)$$

also holds, then all three classes will exist in the steady state[20]. Figure 5 below illustrates a configuration of (33) compatible with case 2 of proposition 2, along with the behaviour of λ and k/g as wealth evolves. Figure 6 does the same for case 1.

$\bar{w}$ is obtained simply from equating w_{t+1} (θ_t=1) in (33) for $w_t \in [w^{**}, \infty)$, to w_t. It is, in other words, the wealth level which generates, for a successful project, a bequest identical to itself. Visual inspection of the transitional diagram suffices to see that $\bar{w}$ will constitute in some sense the upper bound of a limiting wealth distribution. This is because any individual receiving $w > \bar{w}$ as a bequest will necessarily bequeath to her child less than she received herself, and no bequest from someone in [0, $\bar{w}$] exceeds $\bar{w}$. Anyone in [0, w^*) will bequeath more than she received, but in [w^*, $\bar{w}$] there is a positive probability associated with either outcome. In that range, entrepreneurial success leads to upward social mobility, and failure leads to (a rather extreme form of) downward mobility.

Given the nature of the model outlined above, it turns out to be possible to be fairly specific about the long run behaviour of this stochastic dynamic system, as is shown by the following proposition.

Proposition 3: The stochastic process defined by equation (33) is a Markov process, with the property that the cross-section distribution $G_t(w)$ converges to a unique invariant limiting distribution G^*, from any initial distribution $G_0(w)$.

Proof: see Appendix to Chapter 3.

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[20] For (34) to hold, it is clearly necessary - although not sufficient - that the consumption share of lifetime wealth, α, be large enough so that $\hat{r}\lambda(1 - \alpha) < 1$. I assume this to be the case. The intuition is that if savings are too large (α small), fuelling growth, there may be no upper bound on the limiting wealth distribution. On the other hand, if savings are too small (α too close to 1), (34) may not hold, indicating an 'impoverished' ergodic distribution.

Figure 5

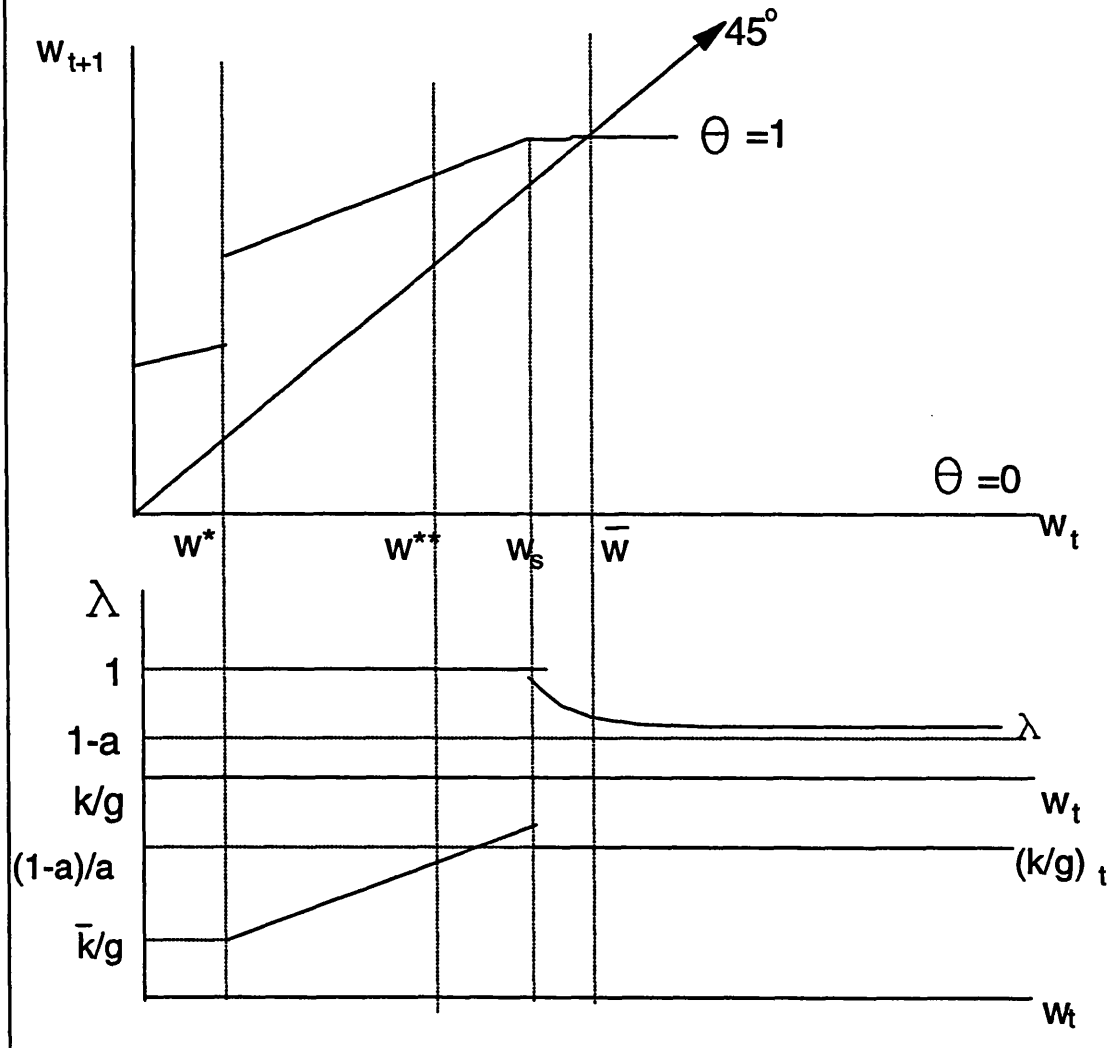
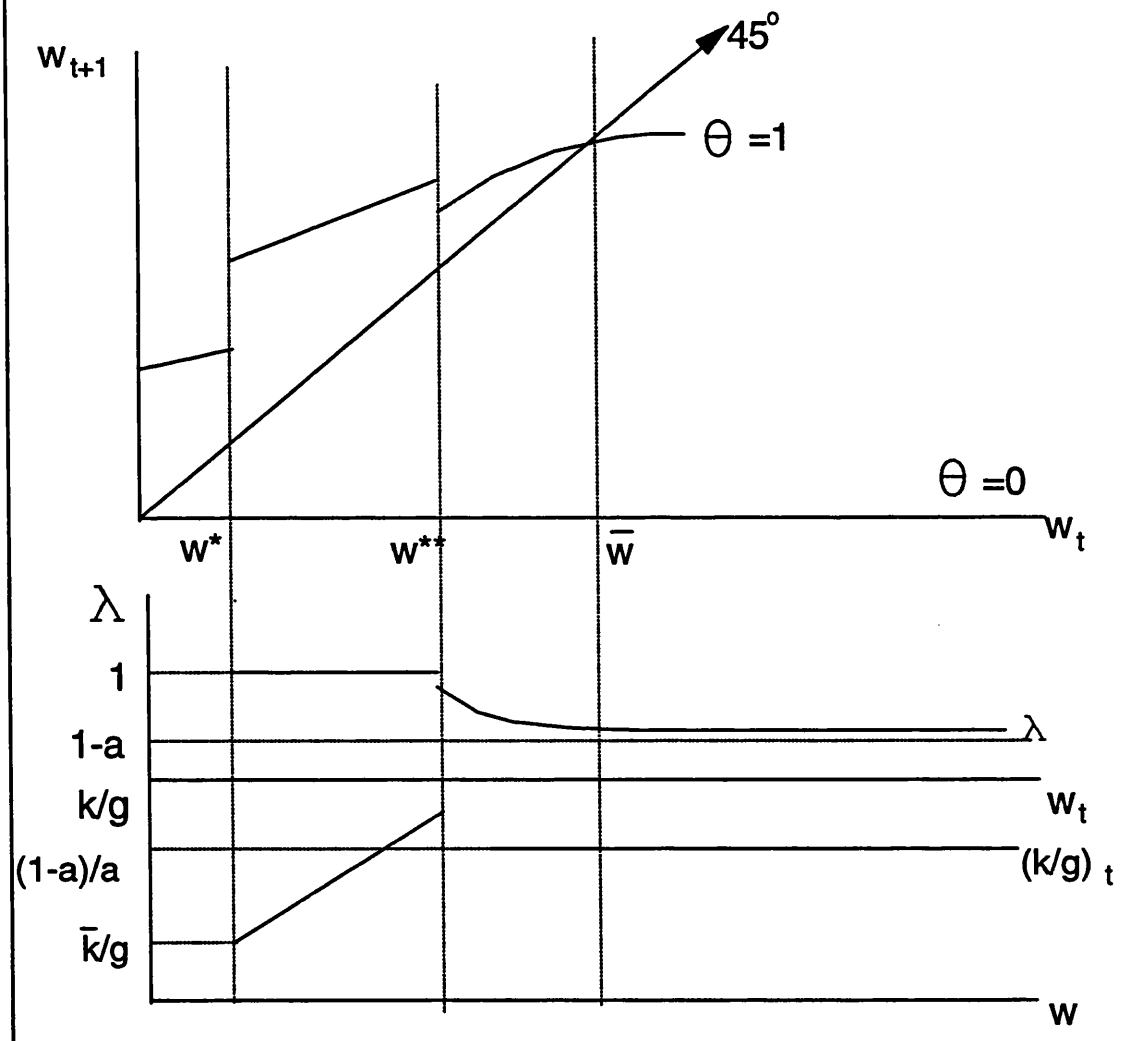

w_{t+1}
45°
θ =1
θ =0
w_t
w^*
w^{**}
w_s
$\bar{w}$
λ
1
1-a
k/g
(1-a)/a
$\bar{k}$/g
λ
w_t
$(k/g)_t$
w_t

Figure 6


w_{t+1}
45°
θ =1
θ =0
w_t
w*
w**
$\bar{w}$
λ
1
1-a
k/g
(1-a)/a
$\bar{k}$/g
λ
w_t
$(k/g)_t$
w

The intuition behind the proof is as follows. We first establish that the process in (33) is a linear Markov process in the set of all possible wealth values. This essentially requires that the expected value of w_{t+1} given w_t be the same as the expectation given the complete history of $\{w_t\}$. Then we show that there is a wealth interval to which any lineage with wealth outside that interval will eventually tend. This is the interval $[0, \bar{w}]$. This is in turn used to show, drawing on an established Markov Convergence Theorem, that there exists a unique invariant probability measure which every lineage will eventually face. Finally, we establish the existence of a law of large numbers which allows us to reinterpret that probability measure as the steady state cross section distribution G*.

This limiting distribution G* is of interest because it is essentially the steady state - or equilibrium - distribution of the system. Proposition 3 is quite a strong result, in that it establishes the existence, uniqueness and stability of such a steady state distribution. It also follows from the analysis that G* has a compact support in $[0, \bar{w}]$, and that w* must belong to this interval. If (34) holds, so will w**, so that the equilibrium wealth distribution in this economy contains three social classes. The poorest people are completely credit constrained. They can not borrow enough to acquire the minimum amount of private capital needed to start a project. They obtain their (deterministic) income from a subsistence activity and from lending their initial wealth at the ruling interest rate.

There is then a middle class which consists of entrepreneurs that use publicly provided infrastructure, government hospitals and schools, and so on. Their projects are risky, but their expected value is high (compared to the alternative subsistence activity). Above them there is a richer group, who also undertake entrepreneurial projects similar to those of the middle class. The difference is that the mix of public and private capital used is different. Whereas the middle classes are unable to borrow enough to buy privately supplied public capital, the rich are able to do so. Their input ratios are therefore unambiguously closer to (and indeed often at) the optimal one. They are therefore able to produce more efficiently than their credit constrained fellow citizens.

6) Policy Impacts on the Steady State Distribution.

In the previous section, I established that the existence of capital market imperfections destroys the first best result that wealth inequalities tend to disappear in the long run. In this model, inequality persists in the long run invariant distribution, in the same way as in other models in this literature. Furthermore, I showed that if the production function uses two complementary inputs, one of which is partially (and freely) supplied by the government, and which I have identified with infrastructure, health or education services, and if there is a fixed cost for acquiring additional amounts of this input privately, then the investing class can be divided into two sub groups.

In this section I establish that, over a plausible range, increasing government expenditure in infrastructure not only increases the aggregate wealth level in steady state,[21] but also reduces inequality of opportunity between the middle and upper classes (Proposition 4). I also return to the case where $g_g < \bar{g}_g$, and show that in that case there is a second effect through which increases in government spending can reduce inequality, and have a positive impact on domestic output separate from that of the foreign transfer, which arises through a relaxation in the credit constraint (Proposition 5).

To do so, I wish to concentrate on ex-ante inequality - inequality in the distribution of expected end-of-period wealth at the beginning of the period - rather than on actual realized wealth levels. One reason for this is to abstract from the stochastic nature of the production function, which was made unrealistically stark for mathematical simplicity. Also, the expected payoff Π, defined in equation (14), and the expected rate of return Π/w, are eminently plausible concepts for discussing equality of opportunity.

Proposition 4: Consider case 1 of proposition 2. Then, for all $g_g \in [\bar{g}_g, g_g']$[22], any increase in g_g leads to expected income gains for all agents with wealth greater than w^*, but these gains are proportionately larger for those with wealth $w \in [w^*, w^{**})$ than for those with

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[21] Which obviously follows from the fact that any increase in government expenditure in this paper is assumed to be financed by an identical increase in transfers from abroad. The issue of taxation is addressed in more detail in the next chapter.

[22] Although it is not necessarily always true that $g'_g > \bar{g}_g$, it can be shown that for reasonable values of $\bar{g}_p$ and r, this will hold.

wealth w ∈ [w**, w̃]. That is to say, government spending helps reduce the disparity between the expected rates of return facing the rich - who have access to private infrastructure, education and health services - and poorer entrepreneurs, who are credit constrained.

Proof: Noting that we are still considering case 1 of proposition 1, we can use (14) to write the expected rate of return for agents with w ∈ [w*, w**) as follows:

$$\frac{\Pi}{w} = \frac{\hat{r}}{w}\left(w + \frac{\pi F}{r}\right)^{1-a} g_g^{\,a} - \frac{\pi F}{w} \tag{35}$$

Hence:

$$\frac{\partial \Pi / w}{\partial g_g} = \frac{a\hat{r}}{w}\left[\frac{w + \frac{\pi F}{r}}{g_g}\right]^{1-a} \tag{36}$$

Analogously, the expected rate of return for agents with w ∈ [w**, w̃] can be written as:

$$\frac{\Pi}{w} = \frac{\hat{r}}{w}\left[\lambda\left(w + \frac{\pi F}{r}\right)\right]^{1-a}\left[g_g + (1-\lambda)\left(w + \frac{\pi F}{r}\right)\right]^{a} - \frac{\pi F}{w} \tag{37}$$

So:

$$\frac{\partial \Pi / w}{\partial g_g} = \frac{a\hat{r}}{w}\left[\frac{\lambda\left(w + \frac{\pi F}{r}\right)}{g_g + (1-\lambda)\left(w + \frac{\pi F}{r}\right)}\right]^{1-a} \tag{38}$$

Because $g_g \in [\tilde{g}_g, g_g']$, $\lambda < 1$ for all households with w ∈ [w**, w̃]. This is case 1 of proposition 2. Since $0 < a, \lambda < 1$, the right hand side of (36) is unambiguously greater than the right hand side of (38) and

$$\left.\frac{\partial \Pi / w}{\partial g_g}\right|_{w \in [w^*, w^{**})} > \left.\frac{\partial \Pi / w}{\partial g_g}\right|_{w \in [w^{**}, \tilde{w}]} \tag{39}$$

Hence, an increase in g_g increases the expected rate of return facing poorer entrepreneurs by more than the one facing richer entrepreneurs. ■

Now, (39) implies a reduction in inequality of opportunity iff:

$$\left.\frac{\Pi}{w}\right|_{w \in [w*,w**)} < \left.\frac{\Pi}{w}\right|_{w \in [w**,\bar{w}]} \qquad (40)$$

But this must be true by self-selection, as agents facing Π/w given by (37) can choose to face (35) by setting control variable $\lambda = 1$. If they choose not to do so, as risk neutral agents, it must be because the right-hand side of (37) exceeds that of (35).

This result has therefore established that for a certain range[23], increasing public provision of infrastructure capital reduces inequality of opportunity, as measured by the ex-ante expected rate of return, between poorer entrepreneurs and their richer counterparts. Intuitively, this is because the constant returns to scale production function has an optimal input ratio, which maximises expected returns for a given input expenditure. Whereas the richer entrepreneurs are able to choose that ratio, those who are credit constrained - and therefore unable to purchase extra infrastructure privately - are not. The fact that they are poorer, that is, leads them to face a lower expected return, thus reducing their chances of upward social mobility. By increasing the stock of per capita public capital available, the government is not only increasing wealth, but also increasing equality of opportunity.[24]

Conversely, by reducing public investment (cutting g_g) the government will lead richer entrepreneurs to purchase greater quantities of the private substitute g_p, so as to stay at the optimal production ratio. Since this is impossible for the poor, the expenditure cut effectively worsens the impact of the moral hazard in repayment problem. It is because this problem affects only the poor entrepreneurs that it increases inequality of opportunity.

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[23] Although the proposition is more easily proved for $g_g \in [\bar{g}_g, g'_g]$, the result would still hold (on average) for case 2 of proposition 2 ($g_g > g'_g$), provided $w_s < \bar{w}$.

[24] An appropriate disclaimer here is that the existence of subsistence lenders with deterministic incomes in this model prevents us from stating that increases in g_g will lead to increases in equality of opportunity **over the entire distribution.** They do not use any form of capital, and the increase in its stock makes both kinds of entrepreneurs richer relative to them. Bottom-sensitive inequality measures may therefore record an increase in inequality overall. This is why Proposition 4 is stated in terms of entrepreneurs only. The result is the more relevant the lower k. Indeed, a special case of this model, with no fixed costs to the acquisition of private capital ($k = 0$), would make Proposition 4 applicable to the whole distribution.

Whilst it is possible to make an unambiguous statement about the effect of extra government investment on equality of opportunity, it is much harder to derive analytical results in this model for equality of outcome (i.e. of realized wealth). This is essentially because we know nothing about the specific functional form of G*. The proof of proposition 3 establishes the existence of a unique G*, but says nothing of its shape. The only two categorical statements that can be made about G*, therefore, are: (1) that the support of the distribution increases with g_g, i.e: $\partial\bar{w}/\partial g_g > 0$. This is because, (a)[25]:

$$\frac{\partial \bar{w}}{\partial \lambda} = \frac{(1-\alpha)\hat{r}\frac{\pi F}{r}[1 - \hat{r}\lambda(1-\alpha)] + \hat{r}(1-\alpha)^2(\hat{r}\lambda - r)\frac{\pi F}{r}}{[1 - \hat{r}\lambda(1-\alpha)]^2} > 0 \qquad (41)$$

(b):

$$\lambda = \frac{k}{k + g_p}, \qquad so \qquad \frac{\partial \lambda}{\partial g_p} < 0 \qquad (42)$$

and (c): for $\lambda < 1$, $k / (g_g + g_p) = (1 - a)/ a$, so $\partial g_p/\partial g_g < 0$. Hence:

$$\frac{\partial \bar{w}}{\partial g_g} = \frac{\partial \bar{w}}{\partial \lambda}\frac{\partial \lambda}{\partial g_p}\frac{\partial g_p}{\partial g_g} > 0 \qquad (43)$$

And (2), that the Generalized Lorenz Curve associated with the steady state distribution prior to an increase in g_g, G* (low g_g), **can not** dominate the Generalised Lorenz Curve associated with the distribution after such an increase, G* (high g_g). This is simply because the mean of the former is lower than that of the latter (see Cowell, 1995).

That is to say: ex-ante inequality (of opportunity) decreases unambiguously with public investment financed from transfers from abroad, at least over the interval $[\tilde{g}_g, g_g']$; ex-post inequality (of realized wealth) behaves ambiguously, but we can be certain that the distribution with lower public investment per capita will not have second order stochastic dominance over that with higher g_g.

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[25] Since $\hat{r}\lambda(1 - a) < 1$ from footnote 20, and $\min(\hat{r}\lambda) = \hat{r}(1 - a) > r$ from assumption A2.

These results reflect the central manner in which increases in government spending can create more equality of opportunity in countries where there already is a reasonable amount of public capital (i.e, $g_g > \tilde{g}_g$). But as I stated in Lemma 2, for countries with an anaemic public sector ($g_g < \tilde{g}_g$), entrepreneurial activity is restricted only to the very rich, with everyone else consigned to subsistence work and lending at the exogenous rate. The impact of extra government spending in this scenario is more dramatic, and is the subject of the following proposition:

Proposition 5: If (i): a country has such a low level of g_g that w' > w**,
(ii): a stronger version of assumption A3 holds, so that :

$$\hat{r}\bar{k}^{1-a}\bar{g}_g^{\,a} - r(\bar{k} + g_p') > n \tag{44}$$

then:

a) A unit increase in g_g will reduce the minimum wealth required for investment by a unit, thereby unambiguously increasing the number of agents involved in domestic entrepreneurial production;

b) This will lead to an increase in overall income additional to the increase in returns to those who were already investing.

Proof: a) Equation (21), which defines g_p', can be written explicitly as:

$$g_p' = \left[\frac{r}{\hat{r}(1-a)}\right]^{\frac{1}{a}}\bar{k} - g_g \tag{45}$$

So (20) can be expressed directly as a function of g_g:

$$w' = \left[1 + \left(\frac{r}{\hat{r}(1-a)}\right)^{\frac{1}{a}}\right]\bar{k} - g_g - \frac{\pi F}{r} \tag{46}$$

Clearly,

$$\partial w'/\partial g_g = -1 \tag{47}$$

which proves part (a).

b) Call w' before the increase in g_g: w", and that after the increase: w'". Then the gain in income from the increase is given by:

$$\Delta Y = \int_{w'''}^{w''} [E(\Pi(w)) - (n + rw)]dw \qquad (48)$$

because the law of large numbers is applicable to the continuum of agents in [w'", w"][26]. This can be written out as:

$$\Delta Y = \int_{w'''}^{w''} [\hat{r}k^{1-a}(g_g+g_p)^a - r(k+g_p) - n]dw \qquad (49)$$

This expression is positive by (44), because, at w'", $g_p = g_p'$ and the first term within the brackets is equal to the first term in the left hand side of (44), by the definition of g_p'. As wealth increases from w'" to w", the value of the bracketed expression only increases.■

Intuitively, proposition 5 captures the fact that when a country has so little infrastructure that it is not worthwhile even for those people who can afford to buy private capital to invest, and only those who can afford to buy that as well as a complement of privately supplied public capital are in business, then increases in government spending reduce the amount of g_p which is required to make investing at home as profitable as lending abroad. This in turn reduces the minimum wealth at which people find it worthwhile to invest (w'), thereby expanding opportunities to poorer people, and expanding domestic activity. These gains in output and income will occur until w' is driven down to w** (i.e. g_p' is driven down to $\tilde{g}_p$). Any further increases in g_g will not lead to extra output until it reaches $\tilde{g}_g$, because in that intermediate range, the agents which would like to invest are credit constrained and can not buy the necessary amounts of g_p.[27]

7) Conclusions.

This chapter combines a capital market imperfection of the moral hazard in repayment

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[26] See step IV of the proof of proposition 3.

[27] Note that to be sure of preventing a collapse of the limiting invariant distribution to a single point (a poverty trap), the assumption in the first inequality of footnote 15 (A3), needs to be strengthened. Instead of $(\bar{k} - \pi F/r)$, write w'.

variety with a production function where private capital is complementary to the output of public investment. This combination of plausible assumptions generates a unique, invariant steady state wealth distribution, to which the system converges from any initial distribution (Proposition 3). This distribution G* is non-degenerate - meaning that wealth inequality persists in the long-run - and a set of parameter values exists such that it will include three social classes. The poorest members of society (with wealth less than w*) are so tightly credit constrained that they are unable to afford the fixed start-up costs required to invest in any project. In this model, they dedicate their full effort supply to a subsistence activity, and lend whatever wealth they have in the open international capital markets (Lemma 1). Alternative stories might have been told, involving monitoring technologies à la Banerjee and Newman (1993), where they would have been employees instead of subsistence farmers. This may well be an interesting approach, but I have chosen to avoid the complications of an endogenous labour market in this model.

The middle class ($w^* \leq w < w^{**}$) is wealthy enough to be granted loans which enable them to buy the necessary amounts of private capital to invest domestically. But their credit ceilings prevent them from acquiring private substitutes for public infrastructure, health or education (Proposition 1). Only the richest class (composed by those with wealth greater than w^{**}) is able to complement the free public provision of these services with private alternatives, should it be profitable to do so. Unlike the middle class citizens, who might choose to lend some of their wealth at the international rate r, the rich always prefer to invest at home, given that they are generally able to allocate their investment optimally between the two inputs, and therefore face a higher expected return to their projects (Proposition 2).

To concentrate on the impact of changes in public investment which are brought about by changes in external financing, such as in the aftermath of the debt crisis of the 1980s, I assumed that, although expenditure is partly financed by domestic taxes, any change in expenditure mirrored a change in transfers from abroad, with the tax rate τ fixed. A lower bound in per capita levels of expenditure was derived, below which the middle class disappears. With minimal government expenditure on schools, hospitals, roads, telecommunications and the like, domestic production becomes unviable for all but the very rich, who can afford to build their own infrastructure (Lemma 2). These are highly polarised societies, with masses of poor subsistence farmers and artisans, and a small -

highly privatised - modern sector. Increases in government investment in such an environment not only increase the returns to those who are already investing in the country, but also lead to an expansion in domestic entrepreneurial activity amongst poorer people, previously consigned to the subsistence sector, whose wealth was being lent in the global capital markets (proposition 5).

Even if public expenditure is above that lower bound, so that a middle class does exist, there is a range over which increases in public investment are shown to lead to an increase in (ex-ante) equality of opportunity among entrepreneurs (Proposition 4). If the subsistence sector is relatively small, this can become equivalent to greater equality of opportunity for the whole society. Although the stochastic nature of returns prevents us from being able to say much about the impact on (ex-post) equality of outcome, it is not possible for a distribution associated with a lower level of public investment to dominate (in the Generalized Lorenz Curve sense) one with higher public expenditure.

The general conclusions from this exercise are that the "pure redistribution" policy implications of the literature surveyed by Aghion and Bolton (1992) are too restrictive. In that literature, the long term consequences of transfers to the poor, in terms of effort supply in a rational expectations environment are not discussed. But those, as well as targeting and practical implementation difficulties, are the reasons why developing country governments find it so difficult to run generous rich-to-poor transfer schemes.[28] This chapter shows that 'traditional' roles of the government, such as investing in sectors with high transaction costs or very large positive externalities, can also act to improve both equity and efficiency.

In particular, it is shown that productive public investment can alleviate inequality of opportunity even if expenditures are uniformly distributed, rather than targeted at the poor. This is relevant news for countries where the administrative or political difficulties associated with targeting are severe. Before this conclusion can be seized upon by advocates of universal benefits in general, however, the issue of optimal distribution of

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[28] I continue to ignore, as I have throughout the paper, considerations of political economy. This is despite the fact that they may very well provide the most realistic and important explanations for this absence. These results should be seen as a benchmark for the case of perfectly benign and competent governments.

g_g should be addressed. What if the government is able to costlessly allocate g_g in different amounts to different households? What allocation pattern should it choose? There would appear to be scope for interesting further research into this issue, and into its interplay with different tax rates for different activities, using this dynamic distributional framework. The next chapter provides a preliminary sketch.

In any case, governments should be cautious as they embark in privatisation programmes and search for "private sector involvement" everywhere. There are very good grounds for privatizing inefficient steel mills, and excellent reasons for avoiding running budget deficits over long periods. But if there are sectors where market failures outweigh state failures, so that the government has a comparative advantage in supply, and if there are large costs to acquiring the private substitutes, reductions to public investment in them can be detrimental to both long term efficiency and long term fairness and equity. Similar lessons apply to international agencies and bilateral donors involved in determining transfers from abroad to developing countries. Given that sudden reductions in these have often led to sharp cuts in public investment, it is necessary to take into account their pernicious impact upon growth and equality in the recipient countries.

CHAPTER 4

TAXING AND SPENDING: THE GOVERNMENT IN A DYNAMIC MODEL OF INCOME DISTRIBUTION.

Abstract: This chapter explores some of the determinants of the optimal scale of government activity in a model of the type presented in chapter 3. There is a brief conceptual discussion of various possible government objectives and of its wider policy options, with both tax and expenditure as more general functions of household wealth levels. The formal treatment is restricted to the case of non-targeted expenditures and a proportional income tax, as assumed in the previous chapter. For a government seeking to maximize GNP per capita at steady-state, the optimal tax rate is shown to depend on a number of factors, including the limiting wealth distribution. Conditions are derived for the optimal tax rate to be positive, even in a distributionally insensitive society, and some of its properties are discussed. The chapter both provides support for some of the assumptions underlying the analysis in chapter 3, and suggests a number of questions for future research.

1) Introduction.

The previous chapter suggested a mechanism through which government spending could reduce inequality of opportunity in a society with three defining features: imperfect capital markets; stochastic returns to production; and a production function where private and public capital are complementary. It demonstrated that, in that framework, increases in public investment from very low levels could raise the number of private firms investing at home and consequently gross domestic product. And that even in a higher range of public investment levels, it unambiguously reduced the gap in expected returns between rich and poor entrepreneurs.

However, the description of the government - albeit more complex than in most other papers investigating income distribution dynamics - was still very basic, raising a number of questions. The purpose of this chapter is to consider the role of the government in greater detail, and from a public economics perspective. The discussion touches on government objectives, and on its choices about how to raise and how to spend revenue, in more general terms.

The government of Chapter 3 raised revenue solely through a proportional income tax, with no exemptions. It used this revenue to produce a (rivalrous in consumption) capital good, which it distributed uniformly across all members of society. Section 2 in this chapter discusses explicitly what the government's various objectives might be; what more general policy options might be available to it in pursuit of those objectives; and why the assumptions made in Chapter 3 might be reasonable in that model. It suggests some issues which may deserve further attention from researchers in this field.

Although government spending in Chapter 3 was financed largely by taxes, the tax rate was assumed constant in the analysis. Changes in the supply of public capital g_g originated from exogenous changes in transfers from abroad. Section 3 in this paper investigates what can be said analytically about an optimal tax rate τ^*, subject to the constraints on the type of policies available to the government outlined in the previous chapter and in section 2. In particular, it establishes the condition required for this rate to be positive, implying a role for the government.

In an obvious sense, these are results about the optimal size of government. Section 4 will discuss the determinants of τ^*, and how it responds to changes in various parameters of the model, seeking to shed some light on the factors that influence the optimal size of government in a model of this sort.

2) General Objectives and Policy Options for Government.

It seems appropriate to precede a discussion of what determines the optimal size of the government in a specific context by considering first what objectives it might be pursuing, and second what its policy options are. Below, I refer to a number of different theories of the state, and outline their implications in terms of different objective functions or policy approaches in the context of the model in Chapter 3. Then the general policy options that might be available to a government are discussed, before restricting the range to those considered in the remainder of the paper.

I retain the assumption that this is a benevolent dictatorship, ruling out any principal-agent problems between society and its office-holders. There is no voting, and there are no incentive issues in the conduct of governmental business. "The government", as an agent, has no utility or payoff function of its own. Even so, a completely benevolent government may choose to maximize a variety of plausible objective functions - or indeed not have an explicit objective function - depending on what normative approach it takes to the role of the state. The discussion below draws on Section 11-2 in Atkinson and Stiglitz (1980), without in any way seeking to be comprehensive.

Among the normative theories of the state discussed there, those associated with Nozick and with the Pareto criterion are distinguished by the fact that they generate at best partial orderings across allocations/distributions. They do not rely on social welfare functions as such, and both are crucially dependent on the initial state. In the current context, the appropriate 'initial state' to consider is the limiting distribution $G^*(w)$ to which the dynamic system converges, with $\tau = 0$.

Even if the benevolent dictator is sympathetic to the 'minimal state' approach associated with Nozick (1974), it can be argued that there would still be a role for the government in the framework of chapter 3. This is because, although Nozick argues that the

government has no business redistributing assets amongst individuals, provided the process which generated the observed allocation was just, he did see a role for public provision of some basic services, such as law enforcement and defense:

> "a minimal state, limited to the narrow functions of protection against force, theft, fraud, enforcement of contracts, and so on, is justified..." (Nozick, 1974, p.ix)

This is its part in ensuring a smooth running for the ***process*** which generates the outcomes that it is then not supposed to alter. Interestingly, the income distribution of Chapter 3 is the result of a ***process*** of production, bequest choices and random shocks. Such an endogenous distribution is suitable to investigating roles for government which are compatible even with the stringent requirements of the Nozickian approach.

While defense is undeniably a public good, some elements of law enforcement may have rivalrous consumption. g_g may well be thought of as public policing and the free legal services often made available by the public purse, while g_p is then the fees of better, private lawyers, or indeed the cost of private security firms. And it certainly is not novel to think of security against crime, and a clear observance of property and other legal rights as part of 'infrastructure', or as inputs into private sector production. As Stern put it:

> "We may also include as part of infrastructure what we might term social infrastructure... A system in which individuals behave dishonestly ... or where property rights are unclear may lead to a very wasteful allocation of resources in insuring against dishonesty... or enforcing property rights. The costs involved and the distortion of incentives may constitute serious impediments to growth." (Stern, 1991b, p. 128. See also Stern, 1991a).

Nozick would most probably not accept taxation to finance health and education expenditures as legitimate, but even the restrictive areas which he - following Locke - saw as justifying the existence of a state would be compatible with the model presented in the previous chapter. In this sense, our framework establishes a role for the government compatible with a larger set of normative approaches than the simple cash-transfer policies suggested by Aghion and Bolton (1993) and the literature discussed in Chapter 3-2. In those models, because the government is not involved in the production process itself, the Nozickian approach would imply the complete absence of government.

Furthermore, there is a simple parametric interpretation in this model to distinguishing

such a restrictive view from others more favourable to the state. To do so is equivalent to varying the value of the parameter a in the expected returns from production equation:

$$E\,[\Phi(k_t,g_t)\mid k_t \geq \bar{k}] = \hat{r}qk = \hat{r}k^{1-a}g^{a} \qquad (1)$$

Since g denotes the public capital input, which was defined as the aggregate of the inputs in the production of which the government has a social cost-benefit advantage, it follows that normative views which suggest that there are very few inputs that should be produced by the government imply a small a, whereas those which find it justifiable for the government to be active in a wider array of activities imply a higher value for a. As we shall see in Section 4 below, this will have a direct impact on the optimal tax rate, and hence on the size of the government, as Nozick would have expected. (See also Arrow, 1978, on Nozick's theories.)

The Pareto criterion - which essentially approves of an intervention if it makes at least one person better off, but no one worse off - would also be compatible with some forms of government intervention in this model, although not with the proportional income tax cum homogeneous distribution of capital which has been assumed.[1] This is because all agents with wealth $w \in [0, w^*)$ lose out from such a policy.

It is the utilitarian approaches to social justice, however, that lend themselves best to formalization, as they generate complete orderings of outcomes, given by social welfare functions of the general form W(U), where U is the vector of utility levels of all individual members (indexed by i) of a given society. The Rawlsian maximin approach is a special case, where $W^R := \min_i (U)$. In the current framework, because utility functions are individualistic and effort supplies are inelastic and identical, a Rawlsian government would be indistiguishable from one pursuing full equality of outcome.[2] If public capital g was not a necessary input; in the absence of any administrative constraints, and with information flowing perfectly and costlessly, their optimal policy would be to tax each individual i (after the returns accrue, but prior to the consumption-

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[1] In the general case. It will become apparent after our consideration of the optimal tax rate that if $\tau\,(w < w^*) = 0$ and for some special cases of $G^*(w)$ - e.g. $\bar{w} < w_u$ - some positive tax rates would be compatible with the Pareto criterion.

[2] In the absence of those assumptions, this is not necessarily the case. See Atkinson and Stiglitz (1980, p.341).

bequest decision, as indicated by Figure 3-1) exactly as follows:

$$T(w) = f(w_t, \theta_t) - \int_0^{\bar{w}} f(w_t, \theta_t) dG^*(w) \qquad (2)$$

where the second term in the RHS is the mean of the limiting income distribution (call it μ). Clearly, the tax would be negative for those with incomes below the mean, and positive for those above. The budget constraint would balance, because :

$$\int_0^{\bar{w}} T(w) dG^*(w) = 0 \qquad (3)$$

from integrating (2), the 'integral of a sum' rule, and the fact that mean income at steady state is a constant.

With public capital g as a necessary input, however - as is assumed in thesis - the above tax-and-transfer policy, with no expenditure on producing g_g would **not** be optimal. The optimal policy would be more complex, with (at least) some of the tax revenue being allocated to producing g_g, the allocation rule of which would also be non-linear.

The Rawlsian criterion is an extreme case of a more general class of welfare functions, the Bergson-Samuelson class. They can be expressed in general as:

$$W^{BS} = \int_0^{\bar{w}} \phi(U(y)) dG^*(w) \qquad (4)$$

where $y_i := f(w_i, \theta_i)$ denotes the pre-tax income accruing to agent i at the end of his life, with f(.) defined by equation (3-33). U(y) is the individual utility level as a function of his or her income, and ϕ is a twice differentiable function such that $\phi'(U) \geq 0$ and $\phi''(U) \leq 0$.

This utilitarian formulation equates social welfare with a weighted sum of individual utilities, where the concavity of $\phi(U)$ means that the weights decline with income. A criticism often levelled at this approach is that it requires interpersonal comparability of individual utilities, thus relying excessively on cardinality. Since for any agent making an optimal consumption-bequest choice, the utility function given by equation (3-1) can be

rewritten as U(y) = my - 1, where m is a constant[3], however, this problem can be circumvented relatively painlessly for this model. Taking a linear transformation $U' = m^{-1}(U+1)$, (4) can be equivalently written as:

$$W^{BS'} = \int_0^{\bar{w}} \phi(y)\, dG^*(w) \qquad (5)$$

The linear transformation of the utility function respects all ordinal comparisons that might be made across individuals, and allows for a very simple cardinal interpretation of the utility function: utility is identical to income, and can be measured in money terms.

The degree of concavity of $\phi(y)$ is a measure of how much more heavily the welfare function weighs the incomes of the poor than those of the rich (see e.g. Cowell, 1995).[4] Now, one of the objectives of this chapter is to show that a number of plausible situations exist in which the optimal size of the government - proxied by τ^* - is positive. Since taxation and expenditure policies have a vast redistributive potential, a demonstration that the government should be active (i.e. $\tau^* > 0$) becomes increasingly harder as the concavity of $\phi(y)$ is reduced. Such a demonstration for a social welfare function that places no value on redistribution will imply that scope for government activities can only increase if the government's objective function is characterized by a more concave functional form for $\phi(y)$.

For this reason, I take a linear $\phi(y)$. Without loss of generality, take $\phi(y) = y$. Then:

$$W^B = \int_0^{\bar{w}} y\, dG^*(w) = \int_0^{\bar{w}} f(w_i,\theta_i)\, dG^*(w) = \mu \qquad (6)$$

Equation (6) can be interpreted in a number of different ways. For our transformed utility

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[3] $m := h\alpha^{\alpha}(1-\alpha)^{(1-\alpha)}(1-\tau)$. The taking of τ as a constant in this context is legitimate because, from the viewpoint of the individual maximizing his utility in steady-state, the tax rate is an exogenously given constant parameter. The effect of τ on reducing disposable income is taken into explicit account in the government's maximization problem which determines the actual observed value of that parameter. This is done below, by means of the introduction of ω, the 'zero-tax bequest'.

[4] As has been demonstrated elsewhere, the limiting 'most concave' case corresponds to the Rawlsian welfare function.

function U', this case of the Bergson-Samuelson social welfare function is the Benthamite social welfare function: an unweighed sum of all individual utilities. In addition, because the linear transformation has equated utility with the monetary value of income, this social welfare function turns out to be identical to GNP. And finally, because of population mass one, this is also equivalent to mean income or GNP per capita. In the remainder of this chapter, I will assume that (6) is the government's objective function. Again, by deliberately choosing a government objective that has no regard for equity, I am taking the most difficult case for the government to find a role. A relaxation of this assumption, by taking (5) with a strictly concave ϕ instead of (6), would alter the results of the remainder of this paper only in the direction of increasing the scope for government activity.

In maximizing this objective function[5], the government has a potentially vast array of policy options. It can raise its domestic revenues by levying lump-sum taxes, or by taxing income, consumption, or bequests. In principle, it could also tax investment outlays, in k or g_p. With no migration and perfect enforcement, a lump-sum poll tax is possible in principle. I rule this out on the grounds that it is an unrealistic alternative, rarely observed in practice: "Most of the taxes actually employed by governments are not lump-sum; and the main role of the concept is as a standard for comparison." (Atkinson and Stiglitz, 1980, p.28).

Taxing consumption or bequests at different rates is clearly distortionary, as is taxing investment outlays in public and private capital differently. Taxing consumption and bequests at the same rate is equivalent to taxing income, since income is exhausted between them at the end of the individual's life. Taxing k and g_p at the same rate is equivalent to taxing wealth at the beginning of the period, since it is exhausted in investment. But this is still distortionary in the sense that it would change the threshold at which individuals would prefer the entrepreneurial production function to lending their wealth at the riskless rate r.

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[5] Or, as the preceding discussion suggests, any other social welfare function of the Bergson-Samuelson variety; or indeed in playing a role compatible with the Nozickian or the Paretian approaches.

Because effort supply is assumed to be inelastic at 1, taxing income in this model is not distortionary, provided the marginal tax rate is everywhere less than one. With marginal tax rates everywhere less than one, the agent will still choose the same actions to maximize net income, as she would have done with no taxes. Income taxation has therefore no substitution effect on agent behaviour in this model. Therefore, while they are not lump-sum taxes in the strict sense, they can reasonably be described as quasi-lump-sum.[6] Hence, while there is a wide range of tax policy options, if lump-sum taxes are ruled out it turns out that taxing income is the most efficient alternative.

Even so, without specifying a functional form for T(y), this still leaves an infinite array of possibilities for the government. In the foregoing discussion of the optimal policy for a Rawlsian government where no public capital input existed, we saw one special case for T(y). In chapter 3 and in the remainder of this chapter, I assume that $T(y) = \tau y$, where $0 \leq \tau < 1$ is a constant. This is a proportional income tax regime. Since $T'(y) = \tau < 1$, this special case is a quasi-lump-sum tax. As such, in the context of this model it is an efficient tax policy, compatible with maximizing (6). There is no efficiency-equity trade-off, since the objective function is distributionally insensitive (in the sense that W^B would remain unchanged for any Pigou-Dalton transfer). Naturally, if the social welfare function were instead given by (5), with a concave $\phi(y)$, such a trade-off might arise, and some progressive income tax policies might become preferable.

On the expenditure side, the policy options available to the government are also complex. In principle, the government could even seek to eliminate the capital market imperfection, say by institutional means which raised the default penalty F to infinity. In that case, moral hazard in repayment would cease to be a problem and finite credit ceilings would no longer exist. This would be a first-best intervention, but it is ruled out here on the grounds that the story we are interested in telling relies on imperfect capital markets, which in turn are realistic enough.

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[6] Atkinson and Stiglitz (1980) define lump-sum taxes as "those that do not depend on any action of the individual; there is no way that he can change the tax liability." (p.28). Clearly, an income tax in this model does depend on the individual's investment, work and credit market choices. However, because of the inelastic effort supply assumption, provided that marginal tax rates are nowhere greater than unity, they have no effect at all on the choices a rational agent makes, and thus act as if they were lump-sum.

Without that option, the government could disburse its revenue in two quite different ways: it could make cash transfers, or produce g_g. In distributing g_g, it could do so freely, or it could charge a user fee. In case it distributed it freely, it could choose individual recipient levels according to any function $g_g(w)$. Any non-constant such function would be an example of targeting.

Three observations about the model in chapter 3 may help shed some light on the nature of the optimal expenditure policy. First, even if the social welfare function is distributionally insensitive, as is the case with (6), the general optimal expenditure policy would include some cash transfers. Take an individual with wealth just below w*. g_g is useless to her. But an infinitesimally small cash transfer would have a measurable impact on her own income, and hence on GNP per capita. This is not the only case where cash transfers may be more efficient than producing public capital, but it is sufficient for the claim that the optimal policy would involve some cash transfers. Furthermore, if G(w**) is not too close to 0, it follows intuitively from proposition 5 in the last chapter, that the optimal policy mix will also include some g_g.

Second, there is no reason in principle why an administratively unconstrained government should not apply standard public finance principles to the supply of g_g, and charge a price equal to marginal cost plus any Pigouvian tax.[7] With functioning markets, it is commonly argued that where cash transfers are possible, they are preferable to transfers in kind. In this case, however, the existence of non-convexities in the production set, combined with capital market imperfections, mean that there are situations in which a transfer in kind is preferable to a cash transfer. For example, one in which individual i has wealth $w_i \in [w^*, w^{**})$ and her allocated transfer is less than (w**-w) in value. She would then be unable to purchase any feasible combination of k and g_p and, if she does not receive any g_g, would be constrained to the subsistence sector. She would have been unambiguously better off if she had received the value of her transfer in g_g, rather than in cash.[8]

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[7] Ahmad and Stern (1989) argue that an element of indirect taxation should be added to public sector prices, unless there are strong distributional arguments against it. In this model, though, all taxation has been restricted to be income taxation, for the reasons outlined above.

[8] Although public provision of private goods free of charge is very common in practice, theoretical justifications are relatively recent. In this thesis, it arises from non-

The third observation follows from the other two: because the model in section 3 has heterogeneous agents in a general equilibrium setting with imperfect markets, the optimal policy is in general complex: it would involve some of the revenue being disbursed as cash transfers and some being used to produce public capital. The public capital might in turn be distributed through some combination of sales and gifts-in-kind.

Furthermore, the exact nature of such an optimal policy, implementable by an administratively and informationally unconstrained government, would depend on the specific form of the limiting distribution G*(w) about which, as pointed out in the last chapter, nothing can be said. In addition, it appears unreasonable to assume that the specific identification of individual needs that would underlie the implementation of such a policy is informationally and administratively costless. It is for these two reasons that I ruled out cash transfers and public sector pricing from the model in the last chapter, and assumed that the distribution of g_g was untargeted. I will continue to do so in the remainder of this chapter.

Summing up the discussion so far, we have a government whose objective is to maximise a Benthamite social welfare function given by (6) which, because of the assumptions made about the specific form of the individual utility function, is equivalent to GNP per capita. A government that is administratively and informationally constrained, so that it is unable to levy lump-sum taxes, to make cash transfers, to charge for the inputs that it provides, or to target their distribution in any way. This government will find it efficient to raise domestic revenue by means of an income tax. It will disburse those revenues by distributing public capital uniformly to all agents. The next two sections address the question of the optimal **scale** of this taxation-distribution activity.

However, this section has shown that optimal policies would vary substantially if these assumptions were relaxed. This chapter and the last aim to contribute to an understanding of the role of the government in dynamic models of income distribution, with imperfect capital markets. They show that even such a severely constrained government has a role,

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convexities in the sets of purchasable commodities, but there are a number of other reasons why it can be an optimal policy for the government. See Besley and Coate (1991) and Blomquist and Christiansen (1995) for alternative approaches.

both in raising GNP - contributing to economic efficiency - and in reducing inequality (of opportunity) - contributing to equity.

3) The Optimal Tax Rate τ^*.

The problem facing the government is thus to maximize:

$$W^B = \int_0^{\bar{w}} f(w_t,\theta_t)\, dG^*(w) \qquad (7)$$

subject to:

$$g_{gt} \int_0^{\bar{w}} dG^*(w) = \tau \int_0^{\bar{w}} f(w_{t-1},\theta_{t-1})\, dG^*(w) + X_t \qquad (8)$$

and: $0 \leq \tau < 1.$

The maximand (7) was defined so as to be equivalent to steady-state GNP per capita (an indicator of productive efficiency in the economy). To do so, the Bergson-Samuelson social welfare function defined in (4), which was eventually transformed into (7), was defined in terms of pre-tax, rather than net, incomes. Our social objective is therefore to maximize the total output (income) that the economy produces at steady-state, and the above problem consists of choosing the tax rate that will achieve this.[9] The benefits of the tax will be captured by the effects of public capital g_g on increasing expected output. To capture the costs of the tax, it is convenient to define $\omega_t := w_t/(1-\tau)$, the 'zero-tax bequest'. ω_t is what agents at time t would have received from their parents in a steady-state with $\tau=0$, and can therefore be treated as a constant in the choice of an optimal τ. As τ rises,

[9] An alternative approach would have been to choose the tax rate that would maximize after-tax incomes. That is a different problem, which would be solved by a different tax rate. I have chosen the former approach because, although g does not enter the utility formulation in equation (1-1), in many cases it might be more appropriate to think of g (the quality of hospitals, roads, the postal service,...) as entering both the production and utility functions of private agents. That is part of the rationale implicit in the fourth channel for impact of adjustment on the poor (the entitlement losses from expenditure reduction), discussed in Chapter 1-4. A maximization of after-tax private outputs would, in this model, ignore any such effects. Furthermore, the chosen approach yields clearer interpretations for the determinants of τ^* (see Section 4 below).

$w_t = (1-\tau)\omega_t$ falls accordingly, thus capturing the cost of the tax for this generation's investments. Replacing ω_t into (7), and using the definition of f(.) from equation (3-33), we can rewrite the objective function as:

$$W^B = \int_0^{w^*} [n + r(1-\tau)\omega_t] dG^*(w) + \int_{w^*}^{w^{**}} q[\hat{r}(1-\tau)\omega_t + (\hat{r}-r)\pi F/r] dG^*(w) + \int_{w^{**}}^{\bar{w}} q'[\hat{r}\lambda(1-\tau)\omega_t + (\hat{r}\lambda - r)\pi F/r] dG^*(w) \quad (9)$$

where q and q' are the probabilities of success defined in equation (3-7). Using (6) and the fact that mean income (i.e. GNP) is constant in steady state, (8) can be rewritten as:

$$g_{gt} = \tau\mu + X_t \quad (10)$$

Using the definition of q and q', (10) can be substituted into (9), so that the government's problem is the unconstrained maximization of:

$$W^B = \int_0^{w^*} [n + r(1-\tau)\omega_t] dG^*(w) + \int_{w^*}^{w^{**}} \left(\frac{\tau\mu + X_t}{(1-\tau)\omega_t + \pi F/r} \right)^a [\hat{r}(1-\tau)\omega_t + (\hat{r}-r)\pi F/r] dG^*(w) + \int_{w^{**}}^{\bar{w}} \left(\frac{\tau\mu + X_t + g_p}{(1-\tau)\omega_t + \pi F/r - g_p} \right)^a [\hat{r}(1-\tau)\omega_t + (\hat{r}-r)\pi F/r - \hat{r}g_p] dG^*(w) \quad (11)$$

by choice of τ. The trade-off is captured by the fact that τ enters positively in the round bracketed terms in the second and third integrals, where it finances public capital which raises the probability of success of projects, and negatively in the square bracketed terms, where it reflects the reduction in initial wealth available to purchase private capital, as a result of previous period taxation.[10]

[10] It is because of this taxation in the previous period that we use the 'zero-tax bequest' ω_t, so as to account for the effect of taxation on initial values of $w_t = (1-\tau)\omega_t$.

This is a sum of bounded integrals, and a government which knew the shape of its steady-state wealth distribution, G*(w), should in principle be able to solve the integration and differentiate the resulting expression with respect to τ. Then, $\tau^* = \text{argmax } W^B$.

Unfortunately, we do not know the shape of G*(w), so that an analytical solution to the above maximization is not possible. Rather than simulating a special case, I choose to follow an alternative path below. Acknowledging that a specific value for τ^* will not be attained without specifying the distribution function, I seek instead to establish conditions on G*(w), for which τ^* is positive, meaning that the existence of a government - even one constrained to these policies - is efficient.

To do so, I define the *individually preferred tax rate* of individual i as $\tau_i^* := \text{argmax } E[f(w_i, \theta; \tau)]$. I will show that $\partial^2 Ef_i/\partial\tau^2 < 0$, $\forall w$, $0 < \tau < 1$, so that $\partial Ef_i/\partial\tau\ (0 < \tau < \tau_i^*) > 0$. These results will be used to define the restrictions on G*(w) under which $\tau^* > 0$. Throughout the remainder of this chapter, I make the additional simplifying assumption that F = 0, thus eliminating the domestic credit market altogether. This can be seen as a limiting case of the market imperfection already described, and it does not change the essence of the foregoing discussion in any way, while substantially increasing tractability.

This allows us to write the expected income for a middle class agent as a function of τ:

$$E[f(w,\theta;\tau)]\big|_{w\in[w^*,w^{**}]} = \left[\frac{\tau\mu + X}{(1-\tau)\omega}\right]^{a} \hat{r}(1-\tau)\omega \qquad (12)$$

Maximizing by choice of τ yields:

$$\tau_m^* = a - (1-a)\frac{X_t}{\mu} \qquad (13)$$

where the subscript m stands for middle class. Note that, for the middle-classes, τ_i^* does not depend on the individual's initial wealth. This is not true, however, of the upper entrepreneurial class. Their expected income is given by:

$$E[f(w,\theta;\tau)]\big|_{w\in[w^{**},\bar{w}]} = \left[\frac{\tau\mu + X + g_p}{(1-\tau)\omega - g_p}\right]^{a} \hat{r}[(1-\tau)\omega - g_p] \qquad (14)$$

Maximizing by choice of τ yields:

$$\tau_u^*(\omega) = \frac{a(\omega - g_p)}{\omega} - \frac{(1-a)(X+g_p)}{\mu} \qquad (15)$$

A discussion of the properties of the individually preferred tax rates for both classes is the subject of section 4. In order to continue towards an identification of the conditions under which $\tau^* > 0$, however, it is necessary to look a bit further at the upper class case. (13) is clearly a special case of (15) - when $g_p = 0$ - which is not surprising, since what distinguishes the upper and the middle classes is the former's ability to purchase private g. The general case, however, does depend on the individual's wealth:

$$\frac{\partial \tau_u^*}{\partial \omega} = \frac{a}{\omega}\left(\frac{g_p}{\omega} - g'_p(\omega)\right) - g'_p(\omega)\left(\frac{1-a}{\mu}\right) < 0 \qquad \forall \omega > 0 \qquad (16)$$

The inequality follows from the fact that at the optimal input ratio, $g_p(\omega) = a\omega - (1-a)g_g$, so that $g_p'(\omega) = a > a - g_g(1-a)/\omega = g_p/\omega$, $\forall \omega > 0$.

This means that the tax rate that would maximize expected income for individuals richer than w** is a monotonically decreasing function of initial wealth. In fact, it turns out that (15) yields a quadratic function of ω (the upward sloping portion of which occurs with $\omega < 0$), and the relevant root (i.e the value of $\omega > 0$ that sets $\tau_u^*(\omega) = 0$) is given by $\omega = \mu$ (see Appendix to Chapter 4). The intuition for this result is that because agents with wealth greater than w** are able to purchase g_p, they benefit substantially less from the existence of a government that supplies the free substitute g_g than the constrained middle-class agents, who would simply not be able to use the entrepreneurial production function in its absence. Nevertheless, the government does supply g_g free of charge, so that upper class agents who pay less in tax than they receive in public capital still prefer to pay a positive rate of tax to no government at all. These agents are those with wealth less than the mean. Once an individual's wealth is greater than the mean, she can only be made worse off by a government taxing and redistributing according to our assumptions. Their individually preferred tax rate, subject to our constraint of no negative taxation, is zero.[11]

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[11] This result is analogous to that in a model presented by Atkinson and Stiglitz (1980, pp. 398-405), where agents differ in ability, make different choices regarding their

Equation (16) is an important building block in the determination of the condition under which $\tau^* > 0$. The next step is to investigate the shape of the expected income function $E[f(w, \theta; \tau)]$ when $\tau \neq \tau_i^*$. Twice differentiating (14) with respect to τ yields:

$$\begin{aligned}\frac{\partial^2 Ef}{\partial \tau^2} &= \hat{r}[\underline{a(a-1)}\mu^2[\tau\mu + X + g_p]^{a-2}[(1-\tau)\omega - g_p]^{1-a} \\ &+ 2\underline{a}(1-a)\mu[\tau\mu + X + g_p]^{a-1}[(1-\tau)\omega - g_p]^{-a}\underline{(-\omega)} \\ &\underline{- a}(1-a)\omega^2[\tau\mu + X + g_p]^{a}[(1-\tau)\omega - g_p]^{-a-1}]\end{aligned} \tag{17}$$

Since $(1-\tau)\omega > g_p$ in all cases, so as to allow for the purchase of k, the underlined terms in (17) imply that $\partial^2 Ef_i/\partial\tau^2 < 0$, for all $\omega > 0$, $0 < \tau < 1$. This means that expected income for an agent with initial wealth w_i is a strictly concave function of the tax rate, with a global maximum at $\tau_i^*(w_i)$. As we would expect, it follows that $\partial Ef_i/\partial\tau$ $(0 < \tau < \tau_i^*) > 0$, and that $\partial Ef_i/\partial\tau$ $(\tau > \tau_i^*) < 0$. From our discussion above, and inspection of (13) and (15), it is apparent that τ_m^* is the upper bound of the set of τ_i^*. It follows that if $\tau > \tau_m^*$, it is always possible to raise everybody's income by reducing the tax rate. Hence, $0 < \tau^* < \tau_m^*$.

For a given $G^*(w)$, there always exists a τ^* which maximizes (11). To see under which circumstances it is positive, note that $\exists$ w_u such that

$E[f(w, \theta; \tau^*] > E[f(w, \theta; 0]$	for $w^* < w < w_u$,	**(a)**, and
$E[f(w, \theta; \tau^*] < E[f(w, \theta; 0]$	for $w > w_u$,	**(b)**.

Begin with the case where $w^{**} > \mu$. In that case $w_u = w^{**}$; (a) then follows from the facts that $\partial Ef_i/\partial\tau$ $(0 \leq \tau < \tau_m^*) > 0$ and that $\tau^* < \tau_m^*$. (b) follows from the fact that above μ, even the individually preferred tax rate would be negative, if this were possible. This means that these richer agents have a higher expected income with $\tau = 0$ than with any positive τ. Now, if $w^{**} < \mu$, $w^{**} \leq w_u \leq \mu$. The argument for this relies on three facts: first, if the actual τ is below a person's preferred tax rate, than this person is certainly

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education, and where the government makes only cash transfers. Strikingly, despite this quite different set-up, the authors find that: "...if the representative individual were above the mean, he would not favour the use of income taxation. If the representative man is below the mean...he has a preferred tax rate that is strictly positive." (p.401).

better off with τ than with no government; second, below w**, the optimal τ is certain to be no greater than their individually preferred rate (τ_m*), so they will always gain; third, above w**, the preferred tax rates are either zero - if w** > μ - or they decline with wealth, reaching zero at w = μ. In the latter case, some of the upper classes may still be better off with $\tau = \tau$* than with $\tau = 0$. Figure 1 illustrates the implicit determination of w_u, for some τ* in the feasible range (0, τ_m*).

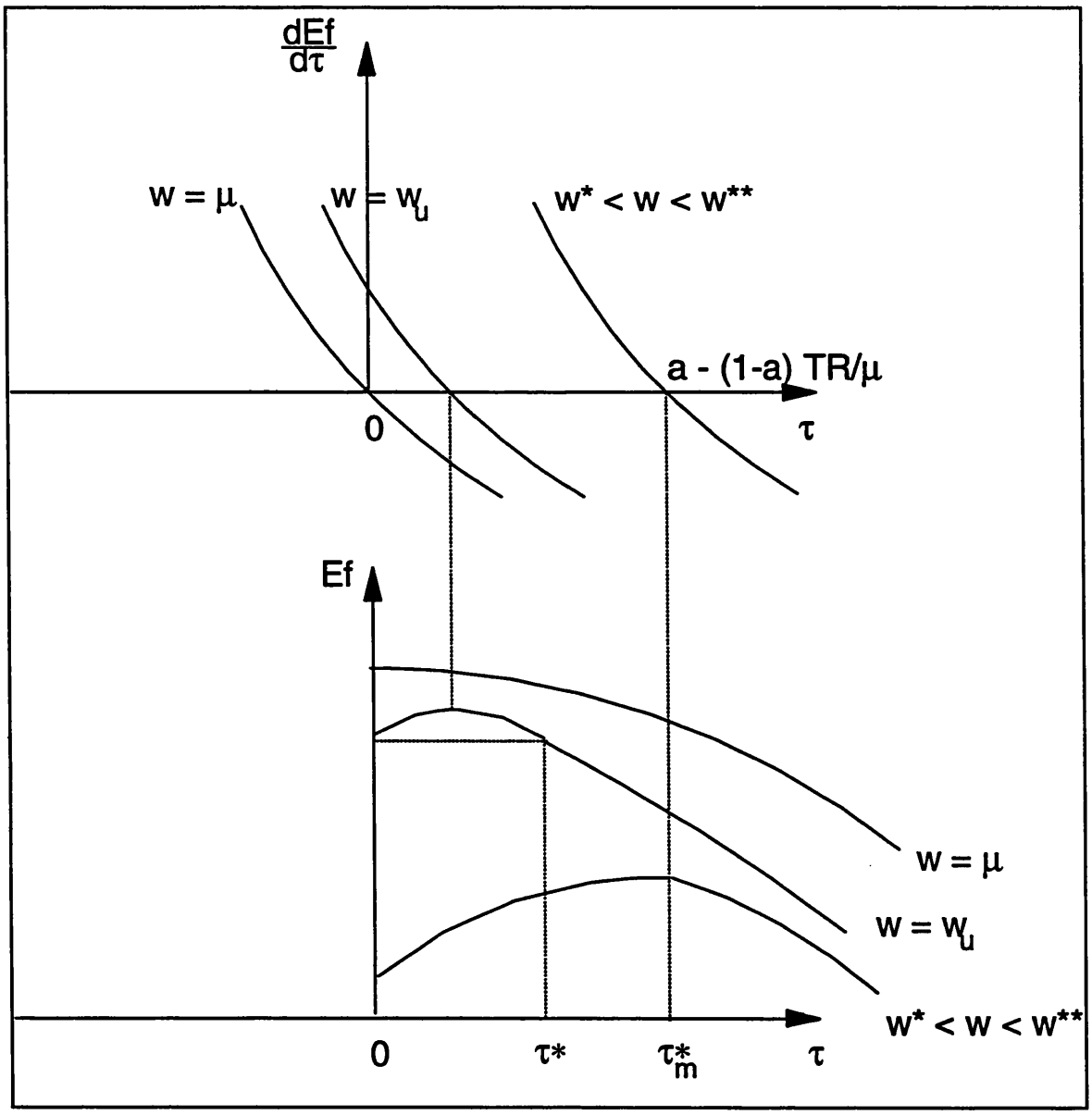

Figure 1: Determining w_u. For a given τ*, E[f(w_u, θ; τ*)] = E[f(w_u, θ; 0)].

Using (a) and (b) above, it follows that $\tau^* > 0$ iff:

$$\int_{w^*}^{w_u} [f(w,\theta;\tau^*) - f(w,\theta;0)]\, dG^*(w) > \tau^* \int_0^{w^*} w\, dG^*(w) + \int_{w_u}^{\bar{w}} [f(w,\theta;0) - f(w,\theta;\tau^*)]\, dG^*(w) \qquad (18)$$

The interpretation of the condition is straightforward: the LHS is the total gain in end-of-period income for those people who benefit from the role of the government, from the existence of a tax rate τ^*. The RHS is the loss to those people who would have preferred no taxation-redistribution, from the existence of such a tax. The first term in the RHS is the loss to the subsistence producers, who can not use any of the public capital they are given. The second term is the loss to the richest agents in society, who are taxed a greater absolute amount than they receive back in public capital.

The main reason why it should be common for (18) to hold is that the integrand of the term in the LHS - the total income gain for all middle class agents[12] - is substantial. With no government, they would be constrained to the subsistence activity, whereas with $g_g \geq \bar{g}_g$, they are able to enjoy the higher expected returns of the entrepreneurial sector. The losses in the RHS, on the other hand, do not involve such qualitative changes in the nature of the agents' occupations: they reflect only the payment of taxes in excess of receipts of public capital.

In addition, the lower w* and the higher w_u, the more likely it is that (18) will hold. This makes intuitive sense: the smaller the group of very poor agents, who live at the margin of entrepreneurial production; and the group of extremely rich people, who prefer to purchase their own private schooling, health care and infrastructure; as compared to the broad section of the population, which benefits from publicly supplied capital inputs, the more likely it is that a benign government seeking to maximize steady-state GNP will have an active role.

At this stage, one might raise the objection that in the context of this very segmented society, our requirement that the proportional income tax be collected from all agents is

[12] And possibly some upper-class ones.

unreasonable. Surely, one could imagine a situation where the informational requirements for the tax department to set subsistence farmers apart from entrepreneurs is not that high. And perhaps exempting those with $w < w^*$ from any tax actually saves on administrative costs, as well as appealing to some sense of justice, since they do not benefit from the existence of the government. If we take these considerations on board, the perfectly linear income tax schedule can be replaced by a discontinuous schedule such as:

$$T(y) = 0 \quad , \quad y \leq n + rw^*$$
$$T(y) = \tau y \, , \quad y > n + rw^*.$$

This would have two implications: it would change condition (18), by eliminating the first term on the RHS, thus increasing the set of $G^*(w)$ for which $\tau^* > 0$.[13] And it would make it easier to introduce equity considerations into this government's objectives, since it exempts from taxation those at the margins of society, whose credit constraints were so severe that they did not benefit from any government investment at all.

4) The Determinants of τ^*.

As it was impossible to solve for τ^* explicitly without knowing the specific form of $G^*(w)$, a round-about approach to defining the conditions under which our government would be active in the economy was adopted. Let us now suppose that $G^*(w)$ is such that (18) holds, and that our government has computed τ^* explicitly for that given steady-state wealth distribution. This section investigates the likely determinants of the magnitude of this optimal tax rate. Although our approach does not allow one to express τ^* explicitly as a function of τ_m^* and $\tau_u^*(w)$, it is intuitive that any factors determining the individually preferred tax rates should also influence the optimal tax rate in the same direction. After all, the individual rates were obtained so as to maximize the expected incomes of those who benefit from taxation, and the optimal rate is the rate which maximizes the sum of all incomes (under our assumptions for the Social Welfare Function).

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[13] At the discontinuity, this income tax schedule is no longer quasi-lump-sum. But because the expected income as a function of wealth is also discontinuous at w^*, a stronger version of assumption A3 (footnote 15) in Chapter 3 can restore that property of the tax, by ensuring that agents' decisions to switch from the subsistence to the entrepreneurial sector is unaffected by taxation. (The income effect, as for any lump-sum tax, remains.)

I now turn to three appealing results about the determinants of the individually preferred tax rates, which turn out to have signs which are independent from the wealth level, and are suggestive of the behaviour of the optimal tax rate.

The first is that the individually preferred tax rates increase unambiguously with the 'importance' of public capital. This is represented by technological parameter a, which is the exponent of public capital g, in the expected returns from production equation (1). Differentiating (13) and (15), we obtain:

$$\frac{\partial \tau_m^*}{\partial a} = 1 + \frac{X}{\mu} > 0 \qquad (19)$$

and

$$\frac{\partial \tau_u^*}{\partial a} = \frac{\omega - g_p}{\omega} + \frac{X + g_p}{\mu} > 0 \qquad (20)$$

where (20) is clearly analogous to (19), and tends to it as g_p tends to zero. These results suggest that the more important public capital is in the aggregate production function of the private sector, or the larger the range of inputs in which the public sector is seen as having a comparative advantage, the greater the government's role that private citizens will demand.

The second result is that individually preferred tax rates decrease with the magnitude of foreign transfers (X), relative to domestic output, being made to the government. Again from (13) and (15):

$$\frac{\partial \tau_m^*}{\partial (X/\mu)} = \frac{\partial \tau_u^*}{\partial (X/\mu)} = a - 1 < 0 \qquad (21)$$

This is also an intuitive result, in that transfers in this model really represent foreign aid, and can by assumption only be used to finance public sector production, so that they reduce the need for domestic financing of the government. This appears to be similar to the old argument that foreign aid is detrimental to the domestic tax effort in developing countries (see e.g. Mosley et al, 1987), which has more recently been sometimes referred to as 'moral hazard of aid'. In fact, large aid to GNP ratios ($X/\mu \geq a/(1-a)$) could drive even τ_m^*, the upper bound for possible values of τ^*, to zero.

While (21) may appear to support that 'moral hazard of aid' view, the original argument pertains to a context where governments are not optimizing, and may be dissuaded from welfare-enhancing taxation by free receipts of foreign savings. That is not pertinent in this model, where the government is optimizing by assumption. What (21) really captures is the best response of a benign government to receipts of aid which can only be invested in g: to reduce the burden of taxation on private agents, allowing them to invest more in private capital. In this model, any wealth which is not taxed is invested in private capital, so that (21) does not capture a disincentive to saving; merely a reallocation in the optimal investment pattern, in response to a change in relative scarcities.

In this context, therefore, potential foreign donors should pay no attention to how their aid affects τ^*. They should focus on the effect of X on GNP or - if they care about equity - on some version of the Social Welfare Function given by (5). While a formal analysis is beyond the scope of this chapter, it is clear that for countries with a high a, and possibly a high G(w**), foreign transfers could have very high social returns.

The third result is that the individually preferred tax rates are monotonically increasing, but concave functions of GNP[14]:

$$\frac{\partial \tau_m^*}{\partial \mu} = \frac{(1-a)X}{\mu^2} > 0 \quad ; \quad \frac{\partial^2 \tau_m^*}{\partial \mu^2} = \frac{-2(1-a)X}{\mu^3} < 0 \qquad (22)$$

The analogous derivatives for τ_u^* can be obtained from (22) by replacing X with $(X + g_p)$. Two points about (22) are deserving of note. First, the fact that in the absence of any transfers both derivatives would be zero simply follows from the fact that the middle classes maximize their expected income when exactly 100a% of the resources available to them is allocated to the government. This is because government provision is the only way they can obtain the public capital input. A tax rate given by (13) would ensure that $a(\mu + X)$ is available to the government. When X goes to zero, τ_m^* collapses to a, and therefore does not vary with μ. What is driving the result of a higher τ_m^* for higher μ is that X is being held constant, so that a larger share of g must be financed from domestic sources.

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[14] Which, as has been noted, in this model is identical to mean income or GNP per capita.

The second point is that this monotonically increasing shape of the individually preferred tax rates with respect to GNP is obtained for a given G*(w). Ie, it would hold if every income in the limiting distribution, including the thresholds w*, w_u and w**, were scaled up in the same proportion as the mean. In the more realistic case of growth in per capita income changing the densities, say, to either side of w_u, (22) would no longer hold and the very shape of the relationship may change. If growth increases the numbers of those who no longer rely exclusively on the state for public capital, generating a boom in private provision of education, health care and infrastructure, then the optimal size of the government may decline with mean income.

As is stated there, the model in Chapter 3 does not feature steady-state growth in per capita income. Further elaboration on the considerations raised in the previous paragraph would require a model which did display steady-state growth. The next chapter does provide such a model, but it is not particularly well suited for this specific issue either, because its assumptions also prevent changes in the composition of the population between those with and without access to private sector alternatives to the government. It attempts to shed light on some changes that arise out of a more careful characterisation of the intertemporal consumption path, including growth, but it does not exhaust the issues to be investigated, and changes in the optimal size of government as a result of changes in composition of the social classes must remain an issue for future research.

5) Conclusions.

This chapter has investigated the possible roles of government in a model of income distribution dynamics with imperfect capital markets and a public capital input into private production. By discussing explicitly a variety of possible objectives the government might pursue, and the wide range of policy options in general available to it, I have extended the scope of the analysis from the preceding chapter. The main results are as follows:

I) Although in general taxation and expenditure have substantial scope for redistribution, this model is compatible with an active government even if society subscribes to a minimalist, Nozickian approach to the state, or if it chooses simply to maximize mean income, without explicit importance being attached to distribution. In the Nozickian case, this is essentially because the government plays a genuine role in the process by which

productive outcomes are generated. In the distributionally insensitive utilitarian case, this is because the government contributes to overall productive efficiency, by reducing the importance of moral hazard in repayment problems and the subsequent credit constraints.

II) In general, with an administratively and informationally unconstrained government, the optimal tax and expenditure schedules T(y) and $g_g(w)$ are complex. User fees may be charged for some provisions of public capital, but these may co-exist with transfers-in-kind and cash transfers, depending on the specific circumstances.

III) Even if we assume that the government is administratively and informationally constrained, and restrict its feasible tax policies to a proportional income tax and its expenditure side to the free-of-charge untargeted distribution of public capital in kind; and even if the government is unconcerned with equity, and aims simply to maximize steady-state GNP, even then it was shown that - provided a reasonably weak condition holds - the optimal tax rate τ^* is positive, and the government is active.

The aforementioned condition for τ^* to be positive is given by (18), which states simply that the income gains from the existence of the optimal tax - as compared to a situation with no government - summed across all those who benefit from it, should exceed the income losses from the existence of the tax, summed across all those who would have a higher income with $\tau = 0$.

IV) Ceteris paribus, τ^* is larger:
a) the larger the technological parameter a, which can be interpreted both as a measure of the range of productive inputs which the public sector has a social cost-benefit advantage in producing, and as a measure of the importance of these inputs, relative to private capital, in raising the expected value of private output;
b) the lower foreign transfers to the government are as a proportion of GNP;
c) the larger the ratio of population mass in the middle class - whose productivity benefits most from government redistribution - to the sum of those in the subsistence class and above w_u in the upper class - who lose out from redistribution. A corollary of (c) is that τ^* is larger, ceteris paribus, the larger the minimum amount of public capital that can be purchased, $\bar{g}_p$.

Chapter 3 showed that some traditional roles of the government - such as the provision of free education and health care services, or of access to infrastructural networks - **can** reduce inequality of opportunity, by giving poorer people access to important inputs they can not purchase privately. This chapter has shown that a benign government, under some administrative or informational constraints, **will** fulfil those traditional roles and have that 'social cement' effect, even if all it cares about is efficiency. It has also argued that if the government did care for equity it would do more, and that if it was less policy constrained, it would still choose to perform some of these activities, alongside other options such as cash transfers.

These results add substance to the view of the public sector and to the meaning of governance inherent in the recent literature on income distribution dynamics with imperfect markets, as well as adding another stream to research on public provision of private goods.

CHAPTER 5

THE DYNAMIC IMPACT OF EXPENDITURE REDUCTION ON INCOME DISTRIBUTION IN A DUAL ECONOMY

Abstract: This chapter extends the analysis of Chapter 3 to a framework compatible with positive steady-state growth in per-capita incomes. It uses a model of the endogenous growth variety, but the focus is on the dualism of the economy: one group has access to a private technology that can be used to substitute for public investment, and the other does not. These groups were derived endogenously in Chapter 3, and here it is shown that their intertemporally optimizing behaviour can lead to ever-increasing divergence, if public investment falls below a certain threshold. Different modelling techniques capture a flavour similar to that of the previous chapter, but interesting differences arise with a more satisfactory characterization of the choice of intertemporal consumption path. The role of public infrastructure, health and education spending as a 'social cement' comes starkly out of the model.

1) Introduction.

Chapter 1 listed five different channels through which the policies associated with structural adjustment might affect the distribution of income. I suggested there that attention had so far focused on the first three, namely relative price effects, labour market effects and asset price effects, but that the last two - changes in household 'unpriced' entitlements as a result of government expenditure reduction and long term effects on capital accumulation - may also play an important role. The last two chapters analyzed these two effects, by means of a model where a reduction in public investment had a negative impact on steady-state output and on the distributions of income and wealth.

Nevertheless, as was pointed out in the literature survey in Chapter 3, any model which generates an invariant limiting wealth distribution necessarily requires assumptions which rule out an important stylized fact of economic dynamics: growth in per-capita incomes. As Reynolds (1983) and Chenery et al (1986) - among others - have documented, a stagnant GNP per capita in the long run is the exception rather than the rule in actual economies.

The use of Markov processes as a modelling tool in the literature described in chapter 3 is well suited to studying the dynamics of income distributions, because of the convergence theorems which establish the limiting probability distribution of outcomes facing an individual agent, and of the existence of a law of large numbers which allows us to reinterpret that probability distribution as a cross-section income distribution. The cost of this modelling device, however, is that it constrains the modeller to live in a world without growth. Efficiency considerations, such as can be made, are couched in terms of steady-state output levels, rather than growth rates. This is unhelpful for formulating policy advice, or indeed for understanding a world where the main indicator of medium to long-run country performance is the growth rate. The marriage between distribution and growth theories is not yet complete.

This chapter combines insights from the dynamic distributional analysis of chapter 3 with some simple lessons from endogenous growth theory. The focus of the analysis is still the role of government. More specifically, it is still the effects of a reduction in public investment on income distribution over time, when markets are imperfect. But this chapter

concentrates on a more careful description of the intertemporal consumption choices of agents, and it is from this that growth will arise. The crucial assumption that allowed a model with constant returns to accumulatable factors **not** to generate steady-state growth was the 'warm-glow' bequest motive embodied in the utility function (1) of chapter 3. The reader will recall that for a bounded limiting distribution to exist, a parametric restriction had to be placed on α, the exponent of consumption in the Cobb-Douglas utility function.[1] This restriction was a lower bound on α, that is: a minimum share of income that had to be consumed at the end of every period. Clearly, this imposed an upper bound on savings, and hence on the speed of capital accumulation.

Below, I will replace the successive generations model of chapter 3 with infinitely lived agents maximizing an (identical) intertemporal utility function. The production functions available to them are expressed slightly more generally, and in a format common to the endogenous growth literature. They are no longer stochastic, but are otherwise closely analogous to those in chapter 3; they certainly have the same returns to scale properties. But combined with the new intertemporal preferences, they generate a simple two-sector endogenous growth model, suitable for investigating the consequences of an external shock leading to expenditure reduction, for both the overall growth rate and for equity.

The main result is that a cut in public investment - government expenditure on infrastructure or anything else that may enter as an input into the production process of household-firms - will not only reduce the economy's growth rate, but may also lead to increasing inequality, if some people are more dependent on the government than others. It extends the results of chapter 3 to a case in which saving behaviour is less ad-hoc, as it is based on full intertemporal optimization, satisfying the Keynes-Ramsey condition that agents' marginal rate of intertemporal substitution must be equal to their marginal rate of transformation along the optimal path. Combined with the usual endogenous growth assumption of constant returns to the accumulatable factors, this generates positive growth. This chapter establishes that growth by itself is not sufficient to eradicate inequality. In fact, in the presence of a market imperfection, such as the one borrowed from the previous chapters, it can lead to ever-increasing inequality, in a case of *polarizing growth*.

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[1] See footnote 20 in chapter 3.

In this case, the lower growth rate of income for the government-dependent poor is due not only to the (exogenous) fall in the growth rate of public expenditure, but also to an induced effect on their optimal savings rate. The marginal product of their private capital is reduced, their marginal rate of transformation falls, and they therefore (rationally) expect to get fewer units of future consumption for any unit of current consumption that they give up. The cut in government expenditure on infrastructure therefore impacts both directly and indirectly, and has the effect of reducing the rate of accumulation of private capital as well.

The motivation for the inclusion of government expenditure as an input into production is, as before, the observed complementarity between public and private capital in generating output. A factory needs electricity supplied by the public sector, roads on which to drive the lorries that will carry its output to market, and benefits from the skills its workforce has learned in public schools and from the fact that workers recover from illness in public hospitals more rapidly than they would at home. Mines and plantations need railroads to take their produce to ports and cities, and some may benefit from public irrigation schemes. Shops and offices use public telecommunication and postal services. Although endogenous growth models such as Romer (1986) have not denied the importance of this public-private complementarity, neither have they focused explicitly on it, as the assumption of an aggregate capital stock, and hence aggregated investment decision, overlooks important issues of the role and size of the state in the development process.

Stern (1991b) drew attention to these issues as deserving further investigation in the study of the determinants of growth, and specifically suggested that: "if we go beyond the aggregate, however, there are two further crucial issues which arise: (v) infrastructure, and (vi) the allocation of output across directly productive sectors..." (Stern, 1991b, p.128). Barro (1990) looked at the first of these issues and sought to determine, in a long run context, the optimal size of public investment, as a result of the trade-off between its contribution to production and the inefficiencies it induced through taxation, notably on the returns to private investment.

In this chapter, I depart from Barro's analysis in two important respects. First, there is no taxation; my analysis of the optimal tax rate and size of the government, in a context with

explicit income inequality, was contained in chapter 4. The government acts merely as a distributor of the net resource transfer the country receives from abroad. This is exogenous, and changes therein will proxy for the credit collapse which led to the debt crisis of the 1980s, whereby the current account deficits of many countries had to be sharply reduced. Second and most important, although Barro does consider the two technologies described below, he considers them in turn, whereas I ascribe each to a sector. The sector 2 technology is a pure private capital alternative to sector 1 technology. Barro's paper was an important contribution to thinking about the role of government in growth; not about its impact on the dynamics of income distribution.

This chapter draws on the previous chapters in one particularly important respect. Here I assume simply that there are two types of people: those who, by virtue of their wealth, family name, personal acquaintances, or other assets have sufficient access to capital that they can embark on the large projects that are required to substitute for public investment, and those who do not. Clearly, this assumption is a short-cut to the endogenous derivation of the two entrepreneurial classes of chapter 3. There, the different input ratios and rates of return to investment where the result of agents making optimal choices in the face of credit market imperfections and given their initial wealth levels. Membership of each sector was therefore endogenous and, furthermore, lineages moved across sectors over generations. That was a richer story, and the cruder assumption of fixed sector membership below is merely a simplification well suited to the analysis in this model.

The chapter is organized as follows. Section 2 briefly tells a two-period story, which brings out the main results very clearly. Then, in section 3, I switch to a continuous time, infinite horizon framework and look at the optimal path for such an economy when there are no capital market imperfections (i.e. any convex combination of the two technologies is available to all). This provides us with a benchmark for comparison with the more interesting case where there are two classes, with asymmetrical access to the two technologies. Section 4 extends the analysis by making a more nuanced assumption about access to sector 2 technology, thereby deriving a more realistic distribution of growth rates. Section 5 concludes.

2) The Two Period Story.

There are two groups of agents: N household-firms[2] (or consumer-producers), each of normalized size 1, and a benign government. All household-firms live for two periods and maximise:

$$U(c_0^i, c_1^i) = U_0(c_0^i) + U_1(c_1^i) \quad , \quad i = 1,2$$
$$\text{where} \quad U_t(c_t) = \frac{c_t^{1-\sigma} - 1}{1 - \sigma} \quad , \quad 0<\sigma<1 \qquad (1)$$

Equation (1) implies additive separability and a zero pure rate of time preference, following Ramsey (1928). Subscripts denote the time period (0, 1) and superscripts the type of household-firm (1, 2), as defined below. Utility displays constant elasticity of substitution between consumption in different periods, in the standard way.[3] In addition, I make five basic assumptions.

A1) Type 1 people have access to the (homogeneous of degree one) production function:

$$y_t = \Phi(k_t, g_t) \qquad (2)$$

where k_t denotes the stock of private capital available at time t and g_t denotes the stock of public infrastructural services available at time t. g_t is produced by the government from resources it receives from a foreign transfer X_t (which must be used up in period t) and uniformly distributed free-of-charge to all agents in the economy.[4] (2) is continuous

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[2] There are no restrictions on N, so that there is no substantial difference from our previous use of a continuum of agents. But in this simpler model, there is nothing to be gained from straining one's powers of abstraction by imagining such a thing as a 'continuum' of people...

[3] I impose an upper bound of 1 on σ, so as to rule out the "infinite agony, finite bliss" case. This imposes a lower bound on utility, thereby preventing low consumption levels from generating unreasonably large and negative values of utility, which could upset the generality of some of the results that follow.

[4] See chapter 3 for the definition and properties of g, and chapter 4 for a discussion of more general government policies, and the role of taxation.

up to the first derivative. The following standard conditions are assumed to hold: Φ_1, Φ_2, $\Phi_{12} > 0$; Φ_{11}, $\Phi_{22} < 0$; $\Phi(k,0) = 0$; $\Phi_1(0,g) = \infty$; $\Phi_1(\infty,g) = 0$, $\Phi_1(k,0) = 0$, and $\Phi_1(k,\infty) = \infty$.

A2) Type 2 people have access to production function (2), as well as:

$$x_t = Ak_t \qquad A>1 \qquad (3)$$

y_t and x_t are the quantities of an identical, homogeneous good produced by sector 1 (technology (2)) and sector 2 (technology (3)) respectively, where the sectors differ only in the technology of production. I assume that these agents can choose between allocating **all** of their capital (k_t) to (2) **or** to (3), but a convex combination of both technologies is not feasible to any individual. This is a departure from the weaker assumptions of chapter 3, where unconstrained (upper-class) agents could use the g_g they received and top it up with g_p. We have dealt with that more general case there, and this assumption will simplify the analysis below while remaining faithful to the spirit of the story.

A3) Both k and g depreciate at 100% per period. I.e., k_1 is equal to investment in period 0.

A4) k_0 and g_0, which are both given exogenously, are such that $Ak_0 < \Phi(k_0, g_0)$.

A5) The exogenous level of g_1 ($< g_0$) is such that $Ak_1^* > \Phi(k_1^*, g_1)$, where k_1^* is given by $U'(c_0)/U'(c_1) = \Phi_1(k_1^*, g_1)$.

(A4) and (A5) are assumptions about the exogenous path of public capital g which, as stated above, is given by the path of foreign transfers made to the government. The assumptions mean that the government-dependent technology, to which everyone has access, is the most productive at t=0, given initial levels of expenditure by the government (and the initial capital stock). But given the lower level of g_1, the optimal level of private investment in technology (2) - i.e. that which equates the marginal rate of substitution to its marginal rate of transformation - is less productive in that technology than if used in the private-capital-only technology (3).

It follows from these assumptions that type 2 people will then produce $\Phi(k_0, g_0)$ at t=0 and Ak_1 at t=1. After all, if they choose to use technology (2), they will set $k_1^2 = k_1^*$,

which is the investment level which then maximizes their utility. But then it will be in their interest to use technology (3), because of A5. Hence if they choose any $k_1^2 \neq k_1^*$, it must be because $Ak_1^2 > Ak_1^* > \Phi(k_1^*, g_1)$. Their problem is therefore to:

$$Max \quad \frac{(c_0^2)^{1-\sigma} + (c_1^2)^{1-\sigma} - 2}{1 - \sigma} \tag{4}$$

s.t. $\Phi(k_0, g_0) = c_0^2 + k_1^2$ and $Ak_1^2 = c_1^2$.

This is a simple maximization in one variable, the choice of c_0 or, equivalently, of k_1. Similarly for type 1 people, who are constrained to using the government-dependent production function, and thus maximise (4), with superscripts 1 instead of 2, subject to:

$\Phi(k_0, g_0) = c_0^1 + k_1^1$ and $\Phi(k_1^1, g_1) = c_1^1$.

Proposition 1: Type 2 people invest more than type 1 people. ($k_1^2 > k_1^1$).

Proof: see the Appendix to Chapter 5.

Corollary 1: Consumption at period 0 is higher for type 1 people ($c_0^1 > c_0^2$)

This follows directly from:

$$c_0^2 + k_1^2 = \Phi(k_0, g_0) = c_0^1 + k_1^1 \tag{5}$$

Since $k_1^2 > k_1^1$, then $c_0^2 < c_0^1$. ■

Proposition 1 captures the essence of the mechanism through which a reduction in the provision of public capital increases inequality persistently in the growth models of this chapter: by reducing the future productivity of private capital to the government-dependent (type 1) agents, it reduces their incentive to save and thus their growth rates. In Chapter 3, the use of the "warm-glow" bequest motive in the utility function (equation 3-1) meant that a constant share ($1 - \alpha$) of income was saved. Savings (i.e. bequests) were lower for those unable to buy privately supplied public capital because their income was lower. It was the difference in expected rates of return that drove the inequality result (see proposition 4 of Chapter 3), while saving behaviour was unaffected. Proposition 1 shows that when savings respond to the expected future productivity of capital, those less

dependent on the government will - when the private technology is superior to the generally available one - invest more and hence grow more rapidly. As we will see in the infinite horizon version of the model, this effect adds persistence to the results presented in previous chapters.

The intuition behind the proof in the appendix can be understood from the fact that equation (A6) can be rewritten as:

$$\frac{U'(c_0^1)}{U'(c_1^1)} = \Phi_1(k_1^1, g_1) \tag{6}$$

which states the familiar Keynes-Ramsey optimality condition that the marginal rate of intertemporal substitution must equal the marginal rate of transformation[5] along the optimal consumption path, for type 1 individuals. Equation (A2) in the appendix is the analogous condition for type 2 agents, and it can be expressed as:

$$\frac{U'(c_0^2)}{U'(c_1^2)} = A \tag{7}$$

Since $A > \Phi_1(k_1^1, g_1)$, following from assumption A5, the left hand side of equation (7) exceeds that of equation (6):

$$\frac{U'(c_0^2)}{U'(c_1^2)} > \frac{U'(c_0^1)}{U'(c_1^1)} \tag{8}$$

It follows that:

$$\frac{c_1^2}{c_0^2} > \frac{c_1^1}{c_0^1} \tag{9}$$

which just states that the unconstrained people (type 2) will in the situation depicted by this example, choose the steeper consumption path. They are prepared to give up a larger proportion of current income for the sake of higher future income, because their marginal

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[5] The marginal rate of transformation (MRT) differs from the more common form (1 + marginal product of capital) because that form is derived from an assumption of zero depreciation, whereas I have assumed full depreciation.

rate of transformation is higher. The next result should therefore come as no surprise.

Proposition 2: Type 2 people consume more at period 1: $c_1^2 > c_1^1$.

Proof:

$$c_1^2 = Ak_1^2 > Ak_1^1 > \Phi(k_1^1, g_1) = c_1^1 \qquad (10)$$

where the first equality is one of the constraints from equation (4); the first inequality follows from proposition 1; the second inequality follows from assumption A5 and equation (6); and the final equality from the analogous constraint from equation (4) for type 1 agents. ■

Corollary 2: In a population that is heterogeneous with respect to access to a fully private infrastructural technology, a cut in government capital expenditure (from g_0 to g_1) may lead to an increase in income inequality.

Proof: This example was constructed so that:

$$y_0^1 = \Phi(k_0, g_0) = y_0^2 \qquad (11)$$

But we have just proved that :

$$y_1^2 = c_1^2 > c_1^1 = y_1^1 \qquad (12)$$

■

Proposition 3: The welfare of type 2 people is larger than that of type 1 people: $U(c_0^2, c_1^2) > U(c_0^1, c_1^1)$.

Proof: by revealed preference. The choice set available to type 1 agents is a strict subset of that available to type 2 agents. If type 2 agents did not pick (c_0^1, c_1^1), when that was feasible, but instead their maximization led to bundle (c_0^2, c_1^2), it must be the case that: $U^2(c_0^2, c_1^2) > U^1(c_0^1, c_1^1)$. ■

Proposition 3 merely confirms that those with greater production choice sets do better than those with smaller ones. Propositions 1 and 2, however, reveal the interesting possibility that a cut in untargeted investment by the government may increase inequality over time, by reducing the productivity of those who are more heavily dependent on public investment (type 1 people). They are less able to substitute away from government-

provided capital-augmenting services, such as state schooling, health care, telecommunications and indeed all sorts of infrastructure. This is formally captured by Corollary 2, which summarizes the key result of the section: while type 2 agents are able to (at least partly) compensate for spending cuts, due to their access to a private production function, type 1 agents have no such protection. A reduction in (uniformly distributed) expenditure by the public sector can therefore negatively affect their private saving and investment decisions, and lead to greater inequality.

The results of this section are captured in Figure 1 below:

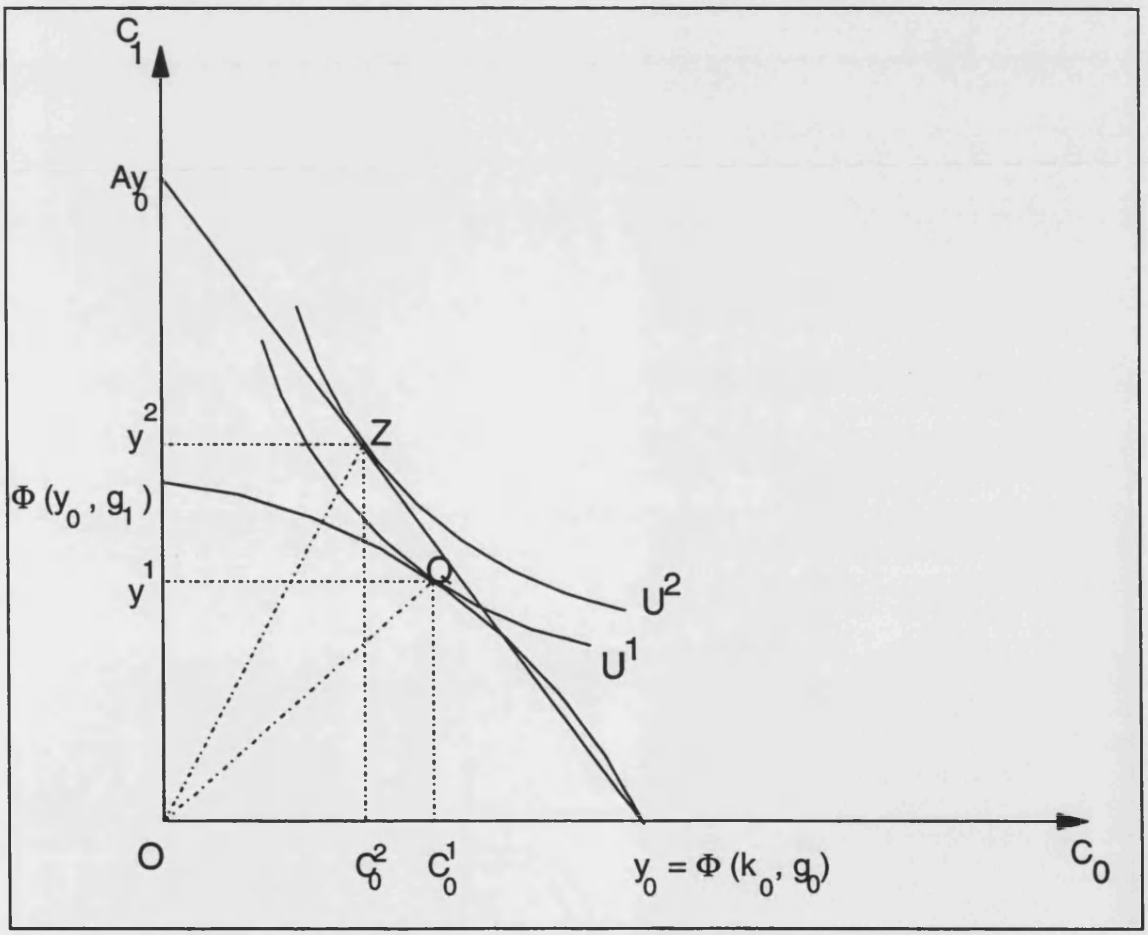

Figure 1: Two-period investment choices by different groups of agents.

This figure depicts the intertemporal consumption choices made by both types of agent. $y_0 = \Phi(k_0, g_0)$ is the maximum possible consumption at t=0, in which case $c_1 = 0$. The maximum consumption at t=1 is obtained by saving all of y_0 at t=0. Along the horizontal

axis, the distance between any c_0^i and y_0 is equal to k_1^i, the savings of household i at time 0. The intertemporal consumption possibility frontiers are thus 'flipped' production functions, with their origin at y_0, and increasing as c_0 decreases. The concave function is given by technology (2), with $g = g_1$, whereas the straight line is given by the private production function (3).

The crucial assumption A5 is represented by the fact that $y^1 = \Phi(k_1^*, g_1)$ is below the Ak line. Tangencies with the (identical) intertemporal indifference curves determine the consumption choices. Because the (absolute value of the) slope at Z exceeds that at Q, $U'(c_0^2)/U'(c_1^2) > U'(c_0^1)/U'(c_1^1)$. Hence $c_1^2/c_0^2 > c_1^1/c_0^1$: the slope of OZ is greater than that of OQ. That is: the growth in consumption is greater for type 2 people.

3) The Continuous Time, Infinite Horizon case.

Having investigated the basic mechanisms of intertemporal choice in this two-technology set-up in a discrete-time, two period model, let us now turn to a continuous-time, infinite horizon framework, in which the main results of the paper are derived. The economy again consists of two groups of agents: N infinitely-lived consumer households, which are also perfectly competitive firms, and a benign government. Following Barro (1990), all households are consumer-producers who choose at t=0 a consumption path so as to maximise:

$$U=\int_0^{\infty} e^{-\rho t}u(c_t)dt \qquad (13)$$

where it is again convenient to assume that:

$$u(c_t)=\frac{c^{1-\sigma}-1}{1-\sigma} \qquad (14)$$

with $0 < \sigma < 1$. Households therefore differ only on the supply side, in that all households have access to a production technology given by:

$$y_t=\Phi(k_{yt},g_t)=k_{yt}\phi(\frac{g_t}{k_{yt}}) \qquad (15)$$

where the conditions in assumption A2 still hold, but type 2 households also have access to a private capital only technology, given by:

$$x_t=Ak_{xt} \qquad (16)$$

If we assume all households are of identical size, normalized at 1 without loss of generality, then y_t and x_t[6] are output per capita in sectors 1 and 2 respectively, and k_{yt} and k_{xt} are capital-labour ratios.[7] g_t is the level of government expenditure at time t. Unlike in Barro (1990), there is no taxation of any kind in this model and the government's budget constraint is simply $X_t = g_t$, which constrains it to balance the budget in every period. I assume that foreigners set the level of transfers X to grow at the same rate as y_t, to enable us to confine the analysis to a comparison of steady-states. This assumption is analogous to the constant proportional tax rate in Barro (1990), and it means that g_t/y_t is constant in steady state. A plausible rationale is that X embodies net investment flows into the production of y_t, and these grow as the sector does, maintaining a constant rate of return. If we prefer to think of X as aid transfers, the $\dot{g}/g = \dot{y}/y$ condition implies a "backing winners" policy by the donors.

The technology which is commonly available to all households is given by (15), and it is homogeneous of degree 1 in both inputs, as implied by the second equality. As in section 2, both production functions (15 and 16) are constant returns to scale in capital alone (although there are two types of capital in 15). This is the assumption that allows for positive per capita income growth in the system. It follows Romer (1986), Lucas (1988), Barro (1990) and much of the extensive literature on endogenous growth, which can be seen as an outgrowth of Arrow (1962).

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[6] (15) and (16) are perfectly analogous to (2) and (3) in section 2. They are rewritten here with subscripts attached to their specific capital-labour ratios for greater clarity in the maximization that follows.

[7] Notice that (13) implies that there is no labour-leisure choice in the model. All households supply 1 unit of labour per period, as in the previous chapters. There now is a pure rate of time preference ρ, for the usual integral convergence reasons. I also assume that $A > \rho > 0$, so that sector 2 is viable.

So as to obtain a benchmark for comparison, let us temporarily relax assumptions A1 and A2, so that all households have access to both technologies. In fact, any convex combination of the two technologies is available to any agent. In this case, each identical household chooses a fraction θ of period t savings to invest in production using technology (16), and the remainder is invested in sector 1, using technology (15). Households therefore maximise (13), subject to:

$$\dot{k}_{xt}=\theta_t(x_t+y_t-c_t) \tag{17}$$

and

$$\dot{k}_{yt}=(1-\theta_t)(x_t+y_t-c_t) \tag{18}$$

But this is a standard dynamic optimization problem in continuous time, with two control variables (c_t, θ_t) and two state variables (k_{xt}, k_{yt}). Although one could use economic intuition to simplify it immediately, let us set up the current value Hamiltonian for the problem in its current form, to obtain confirmation of the intuition from the first order conditions:

$$\begin{aligned} H(c_t,\theta_t,\lambda_t,\mu_t)=u(c_t)+\lambda_t\theta_t[Ak_{xt}+\Phi(k_{yt},g_t)-c_t] \\ +\mu_t(1-\theta_t)[Ak_{xt}+\Phi(k_{yt},g_t)-c_t] \end{aligned} \tag{19}$$

There are six first order conditions, namely:

$$u'(c_t)-\lambda_t\theta_t-\mu_t(1-\theta_t)=0 \tag{20}$$

$$\lambda_t=\mu_t \tag{21}$$

$$\frac{\dot{\lambda}}{\lambda}-\rho=-A \tag{22}$$

$$\frac{\dot{\mu}}{\mu}-\rho=-\Phi_1(k_{yt},g_t) \tag{23}$$

$$\lim_{t \to \infty} \lambda_t e^{-\rho t} = 0 \tag{24}$$

$$\lim_{t \to \infty} \mu_t e^{-\rho t} = 0 \tag{25}$$

Equation (21), obtained from differentiating (19) with respect to the choice variable θ_t, states the obvious result that, since there are no barriers to capital mobility across sectors, the shadow prices of capital in each sector must be identical along the optimal path. This allows us to write:

$$u'(c_t) = \lambda_t \tag{26}$$

which states the usual condition that, at the margin, the value of resources allocated to investment must equate the loss in utility from not allocating them to consumption today. Equations (24) and (25) are transversality conditions, which require that the discounted shadow values of capital in both sectors should tend to zero in the limit.

Using (14), (21), (22), (23) and (26), we obtain the familiar Euler equations for each sector, with the explicit form associated with Constant Relative Risk Aversion (CRRA) utility functions:

$$\frac{\dot{c}}{c} = \frac{1}{\sigma}(A - \rho) \tag{27}$$

and

$$\frac{\dot{c}}{c} = \frac{1}{\sigma}(\Phi_1(k_{yt}, g_t) - \rho) \tag{28}$$

Since (27) and (28) must both hold along the optimal path for this economy, it follows that the marginal product of capital must be the same in both sectors, as we would expect:

$$A = \Phi_1(k_{yt}, g_t) \tag{29}$$

In the steady state, the overall capital stock and output both grow at the same rate as

consumption, which is given either by (27) or (28) above. Clearly, θ will be chosen identically by all households, depending on the (exogenously determined) value of g at time t, so as to equate those marginal products. The Inada conditions in A1 imply that $0 \leq \theta < 1$. Furthermore, since $\Phi_{12} > 0$ and $\Phi_{11} < 0$, $dk_{yt}/dg_t > 0$ along (29), so that $\partial\theta/\partial g < 0$, as we would expect. In other words; the proportion of savings allocated to the government-dependent technology $(1-\theta)$: (a) is always strictly positive, because MPk_y $(k_y = 0)$ is infinite, and (b) increases with g, since MPk_y increases with g, requiring a higher k to keep it equal to A, as required by optimality of intersectoral allocation.

In the absence of some asymmetry in access to the two technologies, this framework will clearly not generate any distributional effect over time. As suggested in chapter 3, inequality amongst otherwise homogeneous agents can only arise if there is some market imperfection. Let us then return to the case we wish to model, in which there are two types of household-producers, by reinstating assumptions A1 and A2.[8] Type 1 agents have access only to production function (15), and type 2 agents have costless access to either (15) or (16). This means that type 1 households are constrained to investing all of their savings in sector 1. They therefore seek to maximize (13), subject to:

$$\dot{k}_{yt} = y_t - c_t \tag{30}$$

This problem corresponds to maximising the current value Hamiltonian function given by:

$$H'(c_t, \lambda_t) = u(c_t) + \lambda_t[\Phi(k_{yt}, g_t) - c_t] \tag{31}$$

The Euler equation that follows from the first order conditions is identical to (28). Because $\dot{g}/g = \dot{y}/y = \dot{k}_y/k_y$, g/k_{yt} and $\Phi_1(k_{yt}, g_t)$ are constants. Given the assumptions made about the derivative signs on (15), (28) by itself implies that this sector's growth rate is a monotonically increasing function of g_t/y_t.

Type 2 households, on the other hand, are those fortunate few who have access to

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[8] Including the ruling out of convex combinations of the two technologies. Type 2 agents may choose between (15) and (16), but must then allocate all their capital to the chosen technology.

sufficiently large funds so as to substitute for public investment privately, if that is profitable. They will choose between technologies 1 and 2 on the basis of which has the highest marginal product of capital. If we for a moment allow ourselves to imagine that they are constrained to investing all of their savings in sector 2, the asymmetry of the problem becomes clear. In that case, their problem would be equivalent to a maximization of the following current value Hamiltonian function:

$$H''(c_t, \lambda_t) = u(c_t) + \lambda_t(Ak_{xt} - c_t) \qquad (32)$$

The Euler equation that is implied by the first order conditions of (32) is identical to (27). It is immediately apparent that the derivative of the growth rate in this sector with respect to g_t/y_t is zero. To proceed, it will be useful to establish the following result.

Proposition 4: $\exists$ $(g/y)^*$, such that:
- if $g/y < (g/y)^*$, then $\Phi_1(k_{yt}, g_t) < A$
- if $g/y = (g/y)^*$, then $\Phi_1(k_{yt}, g_t) = A$
- if $g/y > (g/y)^*$, then $\Phi_1(k_{yt}, g_t) > A$.

Proof: Since k_{yt}/y_t is constant by definition at the steady state, the higher g/y, the higher g/k_y. But $\Phi_1(k_{yt}, g_t)$ is homogeneous of degree zero in both arguments, so $\Phi_1(k_{yt}, g_t) = \omega(g_t/k_{yt})$. Since $\Phi_{12} > 0$, $\omega' > 0$.

Because $\Phi_1(k,0) = 0$, $\Phi_1(k,\infty) = \infty$, $\Phi_{12} > 0$, $\nexists$ a finite limit for $\Phi_1(k,g)$, as $g/y \rightarrow \infty$. This ensures that: $\exists$ g/y such that $\Phi_1(k_{yt}, g_t) < A$

$\exists$ g/y such that $\Phi_1(k_{yt}, g_t) > A$.

Continuity of $\Phi_1(k_{yt}, g_t)$ is then sufficient for the existence of $(g/y)^*$. ■

Proposition 4 establishes that there exists a critical public capital to output ratio, below which the marginal product of capital in the private production function (equations 3 or 16) is higher than that in the technology available to all (equations 2 or 15), and above which that is reversed. This has obvious implications for the investment choices of type 2 agents, who can choose between technologies, and hence to a comparison of growth rates between the two types. We turn to this below.

Figure 2 plots the steady-state growth rates arising from each technology, against the public capital to output ratio:

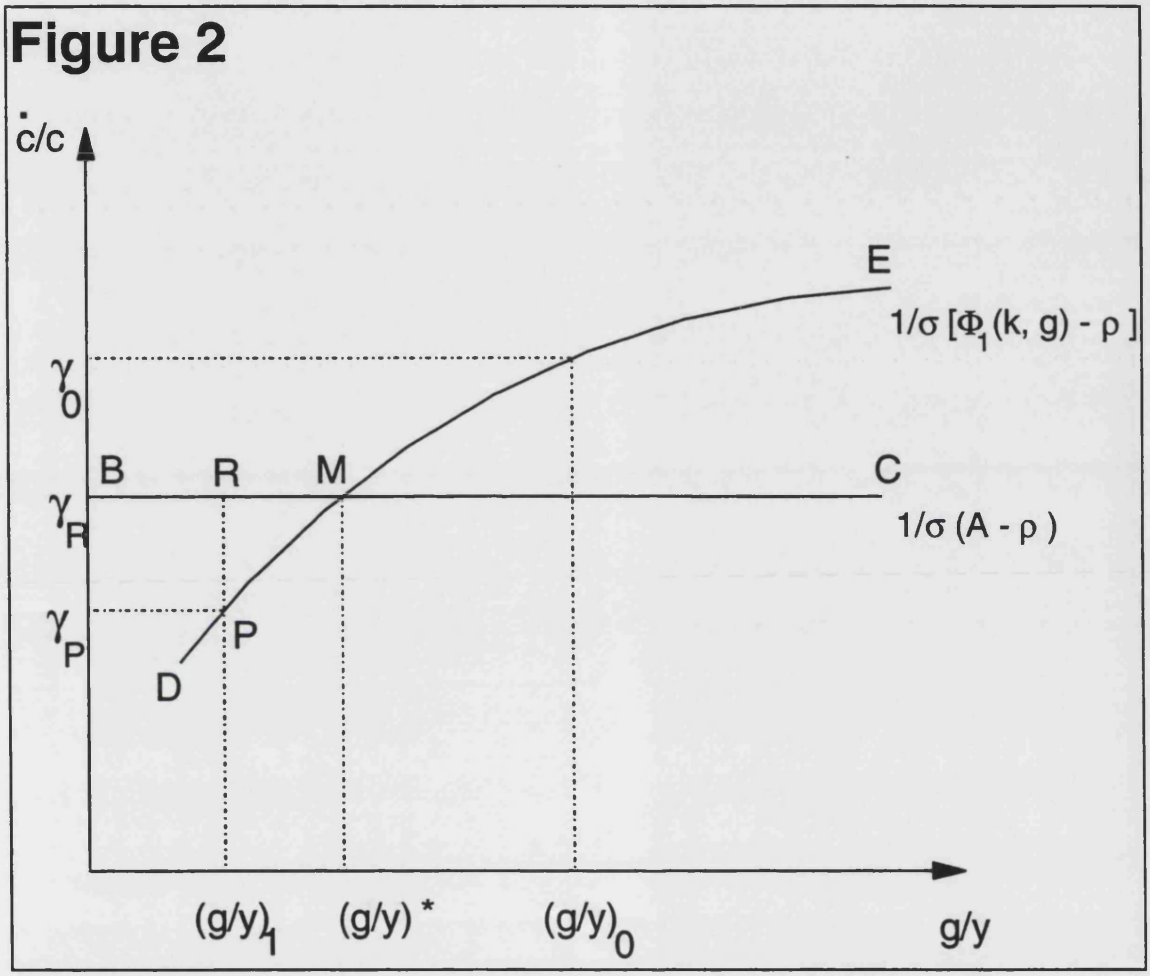

Figure 2: Growth rates for the two technologies, as functions of the public capital to output ratio.

While in deriving the two optimal consumption paths in the above diagram we used the recourse of imagining that type 2 households were constrained to investing only in sector 2, what we are really interested in is the case described earlier, when there is asymmetric access to production possibilities. Namely, I assumed that type 1 households were constrained to sector 1 (i.e. they must lie along DE), but type 2 households could choose between sectors 1 and 2 costlessly so as to maximise their utility.

Proposition 5: If an external shock reduces X at time t in such a way that g/y falls below (g/y)*, then (a): the overall rate of economic growth will fall; and

(b): income inequality (previously non-existent in this economy) will

arise and, given the foreign transfer growth rule, increase with time.

Proof: Since

$$u(c_t) = \frac{(c_0 e^{\gamma t})^{1-\sigma} - 1}{1 - \sigma} \qquad (33)$$

where $\gamma = \dot{c}/c$, it follows that maximising (13) at t=0 is equivalent to choosing the highest rate of growth of output and consumption compatible with the first order conditions. Therefore, type 2 households will use sector 1 technology for g/y > (g/y)* (lying along ME), and switch to sector 2 technology when g/y < (g/y)* (lying along BM). This means that points along segment MC are never used by any household, as they are strictly dominated by switching to the government-dependent technology. If we wish to proxy the adjustment policy in response to an external shock such as those hitting many developing countries in 1982 by an expenditure (level) reduction such that the government share of GDP falls say, from $(g/y)_0$ to $(g/y)_1$, which the rate of growth of foreign transfers is thereafter set to maintain, it follows that a new steady state path arises, with $(g/k)_1 < (g/k)_0$. There are two effects. First, the overall growth rate of the economy falls from γ_0 to $\kappa\gamma_R + (1-\kappa)\gamma_P$, where κ is the proportion of type 2 households in the population. But also, we observe an inequality augmenting effect of the expenditure reduction. Whereas κN households see their income grow at $\gamma_R = 1/\sigma(A - \rho)$, the remaining $(1-\kappa)N$ grow at the lower rate $\gamma_P = 1/\sigma\ [\omega(g/k)_1 - \rho]$. This generates a two-spike distribution of growth rates across society, and also a two-spike income level distribution at any time t, with the spikes diverging over time, for as long as the exogenous capital market imperfection persists and for as long as g/y remains below (g/y)*. ■

Both groups are worse off as a result of the fall in foreign transfers, as we would expect from a contraction in the economy's consumption possibilities set, but it is the government-dependent type 1 people who suffer the greater decline in growth rate. In this model, it is in fact even possible that the fall in g/y brings marginal product Φ_1 (k, g) below the discount rate ρ, leading to negative growth.

The cut in public investment therefore affects not only aggregate expenditure at the time, but also the growth rate of the economy, as described above. In this chapter I emphasized

that the existence of different degrees of ability to substitute privately for government provided services leads to an increase in inequality. Furthermore, because the marginal rate of transformation of those private agents who rely on government inputs has fallen, their own incentives to save and invest are lower. The fall in the growth rate of their income and consumption is the result not only of a direct effect of lower growth in public capital available to them, but also of an induced decline in their own private capital accumulation.

4) An Extension: A More Realistic Distribution of Growth Rates.

The stark dichotomy of the result obtained above, with two diverging but internally homogeneous classes, is a consequence of the assumption that households either have full access to sector 2 technology, or no access at all. While this captures an important cleavage between different groups in some developing countries, it is clearly unrealistic. It is plausible to imagine a society where degrees of dependence on state provisions are more varied. Some households may be unable to build privately the roads and ports they need for their production process, but may be able to afford private schools for their children and a private health insurance, thereby being able to accumulate human capital privately, without need for government expenditure on those sectors. Others may use private mail systems and DHL, rather than be subjected to the delays and risks of the state postal service. Others yet may subscribe to private cellular telephone networks, or buy private electricity generators for their homes and businesses.

This range of different degrees of access to private sector alternative technologies of production can be introduced into the model as follows. Let a variable $\xi_i \in (0, \theta^*(g/y))$, which we may call 'access', represent the maximum fraction of household i savings that can be allocated to sector 2 investment. The absence of a t subscript implies that I assume it to be time invariant for all households.[9] The distribution function $F(\xi_i)$ describes how access to private capital technology is distributed across all households. Now, for $g/y > (g/y)^*$, no household in this economy wishes to invest any funds in sector 2, so the

[9] Notice that unlike θ_t, which was a choice variable, and therefore unconstrained between 0 and 1, ξ_i is fixed for each household $i \in \{1,...,N\}$. Let θ^* be the value of θ which would be chosen identically by all households to maximize (19), for a given g/y.

distribution of growth rates is a mass point at a point along ME, determined by the exogenous level of g/y. For g/y < (g/y)*, on the other hand, all households would ideally like to invest a proportion θ* of their savings in sector 2. As we know from the initial analysis in section 3, any households with $\xi_i = \theta^*$ are able to equate marginal products of capital across the two sectors and reach a first-best allocation.[10] Given the range assumed for ξ_i, however, it is always at or below the optimal fraction, so that it is taken up entirely if g/y < (g/y)*. Agents therefore solve a dynamic optimization problem with a single choice variable (c_t), a single state variable (k_t), and along the optimal steady-state path, household i has a growth rate of consumption, income and capital stock given by:

$$\gamma_i = \frac{1}{\sigma}[\xi_i A + (1-\xi_i)\Phi_1(k_t, g_t) - \rho] \tag{34}$$

This is clearly increasing in ξ_i, as:

$$\frac{\partial \gamma_i}{\partial \xi_i} = \frac{1}{\sigma}[A - \Phi_1(k_t, g_t)] \tag{35}$$

and $A > \Phi_1(k_t, g_t)$ because g/y < (g/y)* and $\xi_i < \theta^*$, $\forall i$.

Equation (34) states that, in this set-up, an agent's income growth rate is an increasing function of a convex combination of the two (sectoral) marginal products of capital, with the weight given by ξ_i. This suggests a society where, in times of low public investment, people will fare differently from one another, with their individual income growth rates positively related to their degree of access to substitutes for publicly provided inputs. Referring back to Figure 2, we therefore have a distribution of growth rates over the N households, whose support is the continuum PR, and which is a functional of $F(\xi_i)$. The higher a household's ability to access the private-capital-only technology, the higher its growth rate after a shock that reduces the government expenditure on social and physical infrastructure below the critical level (g/y)*.

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[10] As ξ_i rises for a given g/y < (g/y)*, k_y/g falls. This raises Φ_1 (k, g), thus shifting DE upwards in figure 2. When $\xi = \theta^*$, the upward sloping growth rate function for sector 1 (DE) intercepts BC at point R. I.e, the interception point M has gradually moved left as the agent has become able to shift an increasing proportion of his savings to the fully private technology, thus raising the MPk in the government-dependent sector.

5) Conclusions.

Building on insights from Chapters 3 and 4, this paper has extended the analysis of the effects of public investment on income distribution to economies with positive steady-state growth rates. Two simplifications were made to allow us to focus clearly on growth: class membership was assumed to be given exogenously in this model, although it was derived endogenously in chapter 3; and taxation, which was considered in detail in chapter 4, was omitted from the analysis.

This chapter replaced the successive generations framework of Chapter 3, where all savings were modelled as bequests. Bequest behaviour was fairly ad-hoc, and subject to parametric restrictions which constrained the rate of capital accumulation. Instead, this chapter had infinitely-lived agents, whose saving behaviour was based on intertemporal utility maximization and which respected the Keynes-Ramsey condition. There were two technologies to produce the same good: one depended on public capital, which could only be produced by the government, and the other was linear in private capital alone. There were also two types of people: those of type 1 could only use the first technology, and those of type 2 could choose between using either.

In this set-up, it was shown that the overall growth rate of the economy depends on the public capital to output ratio (g/y). It was also shown that there is a threshold ratio $(g/y)^*$, above which everyone uses the government-dependent technology, and there is no income inequality. Below the threshold, however, type 2 people switch production to the private technology, and grow at a faster rate than their counterparts of type 1. Income inequality arises, and increases over time so long as the public capital to output ratio remains below the critical threshold. In this case, the larger the share $(1-\kappa)$ of constrained (type 1) agents, the lower the overall economic growth rate.

In the basic version of this two-sector economy, the post-shock distribution of income is rather coarse: a two-spike distribution is derived, because the two different groups are internally homogeneous. Chapter 3 yields a more refined distribution, but Section 4 shows that a more realistic scenario can be derived straight-forwardly within this endogenous growth set-up as well. This is done by defining a variable 'access' (ξ), as the maximum share of household savings that the particular household is 'allowed' to invest in the

private technology (sector 2), and letting it be distributed non-uniformly among the households. It then follows that a more complex distribution of household growth rates will arise, which depends on the distribution of access, $F(\xi_i)$. Naturally, the higher a household's ξ_i , the higher its growth rate.

As the two-period version of the model (described in section 2) established, the main mechanism through which a cut in public investment increases inequality in this model is by reducing the savings incentive of the access-constrained type 1 people. Their marginal product of capital - and hence their marginal rate of transformation - increases with public investment. A fall in the latter thus reduces their willingness to save and consequently their rate of capital accumulation. This is why a one-off reduction in the level of public investment - matched by a reduction in the growth rate of public spending later so as to keep constant a new, lower g/y ratio - can have a persistent augmenting effect on inequality. The ratio of incomes from type 2 to type 1 people increases over time because type 1 people know that they are less productive - since they do not have access to the protected private technology - and hence rationally invest less.

An interesting conclusion follows. It is possible that what may appear to be spendthrift behaviour by the poor - if they save less than richer people - or laziness (in a model where k was interpreted as human capital) - if they invest less in their education - may not be the result of different preferences[11], but of unobserved constraints arising from market imperfections which victimize them. The poor may have exactly the same income-leisure trade-off as the rich, and may save or invest less purely as a result of fully rational behaviour in light of credit constraints or other barriers to the most productive activities.

As I have argued in previous chapters, there are a number of ways in which the government may act so as to correct these imperfections, resulting in both greater equity **and** efficiency. Even if a first-best elimination of the root of the market failure is infeasible, and even if cash transfers are difficult to implement, these models have suggested a reason why in-kind transfers, such as free education and health-care, or spending in infrastructure, may achieve those worthwhile objectives. This should be borne in mind by governments considering the role they desire to play in the development

[11] In plainer English, 'may be no fault of their own'.

processes of their countries.

CHAPTER 6

BRAZILIAN MACROECONOMICS IN THE 1980s: A BRIEF OVERVIEW

Abstract: This short chapter presents some basic macroeconomic facts and figures for Brazil during the 1980s, as a background to the distributional analysis of the period which is contained in Chapters 7 and 8. It briefly describes the instability which characterized the decade, and reports on the various policy initiatives implemented by different governments with the aim of restoring macroeconomic equilibrium. This chapter introduces the third, empirical part of the thesis, and provides information which will be useful for an understanding of the inequality and poverty trends presented later.

1) Introduction.

This thesis has so far dealt with structural adjustment, income distribution and the role of government in the abstract. Chapters 1 and 2 provided a discussion of the background to the reforms of the 1980s and of conceptual channels through which expenditure reduction and expenditure switching may affect the distribution of income. Chapters 3, 4 and 5 focused more narrowly on mechanisms through which sustained (public) expenditure reduction can impact on the long run distributions of wealth and income.

This chapter and the next two constitute the third, empirical part of the thesis. Since long-run data on access to public services and expenditures on private substitutes to those services was not available for Brazil, an empirical test of the implications of the models presented in the foregoing chapters was impossible. Instead, these final chapters consider the more general issue of the behaviour of income distribution during a period of (short-run) expenditure reduction[1] and macroeconomic instability. They do so by means of a case study of Brazil in the 1980s.

In the field of income distribution analysis, Brazil appears to be one of the countries most deserving of study. Of the 71 countries for which the World Development Report 1995 (World Bank, 1995) lists percentage shares of income accruing to different groups, Brazil has the largest share going to the richest 10% (51.3%), and the (joint) second lowest share going to the poorest 20% of its population (2.1%). This comparison appears to support a widely held notion that it is one of the countries with the most unequal distributions of income in the world. But unlike most others who approach it in terms of inequality - e.g. Guatemala, Honduras, Kenya, Panama, South Africa - Brazil is a major world economy, with the world's ninth largest GDP, after the G7 and Spain. It is the largest economy amongst all developing countries, and by far the largest of Latin America.[2]

In addition to this unique combination of size and inequality, Brazil has experienced an

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[1] In the sense of a reduction in the overall level of aggregate demand, not - as we will see below - of public expenditure.

[2] Based on a comparison of GDPs for 1993, from Table 3 in the World Development Indicators in World Bank (1995).

interesting recent economic history. In the 1960s and 1970s, when import substitution industrialization (ISI) and an interventionist state held sway across the developing world, Brazil was one of the largest borrowers and fastest growers of all. In the 1980s, when the debt crisis put an end to that growth cycle, and led to a decade of stagnation for a large number of developing countries - and certainly for those more severely indebted - Brazil was one of the worst hit. The average annual real GDP growth rate fell from 9.0% in 1965-80 to 2.7% in 1980-90 (World Bank, 1992).

In that decade, Brazil and many other developing countries were the focus of a great deal of talk about structural adjustment, and the transition from ISI to a new, export-led and market-based growth strategy. Fiscal restraint and devaluations were to be followed by deeper structural reforms. Trade was to be liberalized, state owned enterprises were to be privatized, tax systems reformed, and financial markets deregulated. But unlike some other countries, Brazil did not successfully implement many of these reforms in the 1980s. The country saw at least four failed stabilization plans, and annual inflation in 1990 was 2,938% (IDB, 1994), the highest in the period. Tariff reductions and privatizations did not begin in earnest until 1990/1. Discussions on tax and social security reforms were only beginning to take place in Congress in mid-1995. In short, Brazil in the 1980s was a country failing to adjust to the debt crisis.

Following the oil price shocks of the 1970s, and the subsequent debt crisis, Brazil teetered on the brink of reform for the whole of the decade. External balance was achieved by means of a severe reduction in imports, as we are about to see. But internal equilibrium, characterised by sustainable growth rates and price stability, proved elusive for a long period, despite a number of failed stabilization 'plans'. This chapter is anchored on some basic numbers, presented in Table 1 below.

The table contains data on a set of variables related to macroeconomic performance in the period. GDP per capita is included as a basic indicator of living standards, and it shows the stagnation which was the hallmark of the decade.[3] Annual growth in GDP and open

[3] Stagnation is revealed by these national accounts data. This is at odds with the growth implied by household incomes reported in the PNAD data, as we will see in Chapter 7. The reasons for and consequences of this are discussed in Chapter 7-3 and 7-4.

Table I: Macroeconomic Indicators

	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990
GDP per capita (1988 US$)[a]	2,252	2,237	2,145	2,118	2,235	2,362	2,394	2,346	2,377	2,233
Annual growth in GDP (%)[b]	- 4.4	0.6	-3.4	5.3	7.9	7.5	3.6	-0.1	3.3	-4.6
Open Unemployment (%)[c]	7.9	6.3	6.7	7.1	5.3	3.6	3.7	3.8	3.3	4.3
Govt spending (% of GDP)[a]	27.3	28.7	31.7	29.9	37.6	35.9	32.4	40.9	46.5	47.2
Fiscal Surplus (% of GDP)[a]	-2.2	-3.1	-4.6	-5.0	-11.1	-13.3	-11.2	-21.4	-24.9	-14.4
Annual Inflation Rate (%)[a]	106	98	142	197	227	145	230	682	1,287	2,938
Trade Surplus (US$ billions)[d]	1.19	0.78	6.47	13.09	12.47	8.30	11.16	19.17	16.11	10.75
Current Account Surplus (US$ billions)[d]	-11.75	-16.31	-6.84	0.04	-0.27	-5.30	-1.45	4.16	1.03	-3.28
Real wages in manufacturing (1980= 100)[c]	96.1	97.7	81.9	80.3	90.6	105.3	112.2	92.2	99.5	80.0

Notes:

[a] Source for 1981-1983: IDB (1991). Source for 1984-90: IDB (1994). Due to data revision, there are some discrepancies between the time-series reported in the two volumes above, but these are not too great.

[b] Source: IDB (1991), p.54.

[c] Source: Thomas, J.J. (1995). Open unemployment is an annual average of monthly data for the metropolitan areas of Sao Paulo, Rio de Janeiro, Belo Horizonte, Porto Alegre, Salvador and Recife.

[d] Source: IDB (1991, 1992).

unemployment proxy for the behaviour of aggregate demand and the business cycle position. The next three variables are indicative of the macroeconomic stance of government policy. The upward trend in government expenditure as a share of GDP (from 27.3% in 1981 to 47.2% in 1990) and the substantial increases in overall fiscal deficit are evidence that the government was not contributing to expenditure reduction through its own accounts. Repeated increases in the rate of inflation (from 105.6% in 1981 to 2,938% in 1990) reveal that macroeconomic stability had if anything become a more elusive goal than in the 1970s. The next two variables reflect Brazil's external position. Here there is evidence of adjustment to the negative shocks of 1979-82, albeit with slips in 1986 and 1990. Finally, real wages in the manufacturing sector are included as an (imperfect) proxy for average real wages across the whole economy.

The chapter is divided into three basic periods: Section 2 discusses the recession of 1981-83; Section 3 deals with the recovery of 1984-85; and Section 4 reports on the populist inflation of 1986-1990.

2) The Recession of 1981-83.

The roots of the external imbalances which led to the debt crisis of the early 1980s lie, as was suggested in Chapter 1, in the choice of response made by many developing countries to the oil price shocks of 1973/74 and 1979/80, which had a massive impact on the terms of trade between oil exporting and oil importing countries throughout the world. While the industrialized countries as a group responded by immediate contractions in economic activity and imports, rather than by accumulating large current account deficits, oil importing developing countries in general - and Latin America in particular - continued growing strongly in the 1970s, financing the larger import bills through ever larger current account deficits.

In the case of Brazil, this led external debt to rise from US$ 12.6 billion in 1973 to US$ 83.3 billion at the end of 1982. Naturally, this led to an ever greater financing burden, which showed up in the interest services item of the current account. Servicing requirements rose from US$ 2.2 billion in 1973 to US$ 11.3 billion in 1980. By 1982, the year in which Mexico defaulted and Western commercial banks virtually ceased voluntary lending to Latin America, servicing requirements were equivalent to 97% of Brazil's entire

export revenue.

It is to the credit of economic policy makers in Brazil at the time, led by Minister Mario Henrique Simonsen, that the need for adjustment to the balance of payments was understood. In 1980, even while the economy was still growing, the government freed interest rates and stepped up the rate of monetary corrections and mini-devaluations, with a view to keeping the real exchange rate competitive, discourage imports and increase exports. In early 1980, the Cruzeiro was devalued by 30%, and in 1981, the rate of nominal devaluation was virtually identical to domestic inflation. At the same time, Simonsen's team eliminated a number of price controls and attempted to deal with excessive public expenditure by creating a Special Secretariat for State Enterprises (SEST), empowered to control budgets across some 370 state-owned companies.

These reforms did not, however, go far enough in the direction of paring Brazil's endemic public deficits which, as can be seen from Table 1, kept on rising gently through the period. This was due in part to the fact that higher international and domestic interest rates kept the overall deficit rising despite a non-negligible reduction in the primary deficit. These higher interest rates, combined with substantial expansions in the money supply and with the effect of the faster nominal devaluations kept inflation quite high in 1981 and 1982, and rising substantially in 1983, despite the recession, which was brought about more by international effects than by the mildly contractionary policies pursued by the government. GDP fell in both 1981 and 1983, and was virtually unchanged in 1982, causing GDP per capita to fall for three consecutive years.

While the combination of stubbornly high inflation and an internationally induced recession meant that domestic indicators looked dismal in 1983, there were nevertheless signs of progress in reducing the current account deficit. This reached its peak in 1982, at US$ 16.3 billion, despite the devaluations and the domestic recession, because international conditions prevented any export gains. Industrial countries were in the throes of their own recessions, so there was no scope for expanding volume, and weak demand meant that the terms of trade moved strongly against Brazil. Export value consequently fell by 13.4% in 1982 alone. (IDB, 1983). But with some improvement in economic activity in industrial countries in 1983, export markets opened up again, and the devaluations pursued by Simonsen's team began to pay off. The current account deficit

was cut by almost US$ 10 billion, to US$ 6.8 billion, well within the target range negotiated with the IMF early in the year.

3) The Recovery of 1984-85.

Following the international recovery with a lag of one or two years, Brazil's GDP grew by 5.3% in 1984 and by 7.9% in 1985. This was due not only to greater demand for Brazilian exports from abroad, but also to a reversal of the contractionary macroeconomic policies pursued in the previous three years, which led to a rise in domestic consumption. The fiscal deficit continued to rise in 1984 and more than doubled in 1985, under the new civilian regime, to 11% of GDP. Indexation became overwhelmingly pervasive, so that not only wages, but almost any contract between economic agents included clauses whereby the nominal value of a variable was changed at the end of a period, so as to restore its real value from the previous period. In particular, this was true of government debt and interest payments on it: estimates of 'monetary correction' payments on the domestic debt soared from 9.1% of GDP in 1982 to some 20.7% in 1984 (IDB, 1985).

The pervasiveness of indexation mechanisms effectively endogenised the money supply, which grew by 203.5% in 1984 and 312.1% in 1985 (M1; see IDB, 1986, p.220). Given these growth rates of the money supply and the steady devaluation of the cruzeiro, it is not surprising that inflation rose further still, to 196.7% in 1984 and 226.9% in 1985. But the devaluations, combined with the improvement in the international environment, led Brazil to achieve at least one of its macroeconomic adjustment policy objectives in 1984. That year, the trade surplus was a record US$ 13 billion, which was sufficient to balance the current account (US$ 42 million surplus). This balance was essentially maintained in 1985.

The basic features of this brief two-year period, between the recession and the launching of the Cruzado plan in 1986, were therefore threefold: growth resumed, based on the strength of the international recovery and on the relaxation of domestic contractionary policies; this relaxation, the growth in aggregate demand and the spread of indexation led to a further acceleration of inflation, to a point where it was perceived to threaten to become hyperinflation; and despite domestic growth, the strength of foreign demand and the maintenance of a competitive exchange rate led to substantial trade surpluses, which

achieved current account balance, for the first time since before the first oil price shock.

4) 1986-1990: Defeat in the Populist Fight Against Inflation.

Despite the remarkable achievement of its predecessors in balancing the current account, which required turning around a US$ 16 billion deficit in two years, the civilian government which rose to power in 1985 was faced with a difficult economic scenario, where rising inflation was the main problem. Given the recent stagnation in per capita incomes, the historically high rates of unemployment, and the rise in poverty in 1983-84 (see Chapter 7-5), tackling inflation through conventional, orthodox means - which were likely to increase unemployment or lower real wages - was not perceived as a desirable option. Indeed, as the IDB (1985) accurately predicted: "... since the clamour to resume growth is becoming increasingly difficult to ignore, it seems likely that the new government will examine various alternative policies - including proposals for monetary reform and deindexation of the economy - for reducing inflation while minimizing further losses of income and output." (p.215).

This was indeed what the government tried to do with the Cruzado Plan of 28 February 1986. This plan replaced the cruzeiro with a new national currency: the cruzado, worth 1,000 cruzeiros. More importantly, it contained a sweeping set of incomes policies such as price and wage freezes and the abolition of monetary correction on any financial asset other than the basic passbook savings account (caderneta de poupança). To implement this, the main financial indexator, the ORTN, was replaced by a fixed factor, called the OTN. All assets which were contracted to be readjusted according to changes in the ORTN were thereby deprived of any form of monetary correction. Rents and mortgage payments were also frozen, and a new unemployment programme was set up, which envisaged the provision of benefits to the unemployed for up to four months.

The price and wage freeze was intended originally as a temporary measure, designed to break the inflationary expectations while the budget was brought under control, and the private sector got used to a new, stable currency. Lara Resende et al (1987) suggest it was not meant to last longer than 90 days. In the event, however, the economists who designed the plan were unable to persuade politicians to adopt the necessary measures to reduce the deficit. The temporary stability of the price level removed the burden of the inflation tax

and transferred real income to wage earners. Real wages in manufacturing in 1986 were up 16% on the previous year (see Table 1). Average industrial capacity utilization rose to 80% (Belluzzo, 1986), and growth continued apace, reaching 7.5% in 1986. Combined to the consumption boom, which drove the growth in output, failure to reduce the fiscal deficit doomed the Cruzado plan to failure. Aggregate demand continued to run at levels well in excess of those compatible with stable prices, and once the freeze was removed, inflation would gradually return.

Despite growing relative price distortions, and increasing evidence of shortages in some sectors, the freeze was maintained until November, when President Sarney's government and his supporters won one of the most comprehensive electoral victories in the history of Brazil (Veja, 1986). Less than two weeks after those elections, Sarney's ministers went on television to announce a new package of measures, including many price rises - some as large as 100% - and tax hikes, which became known as the Cruzado II, and which really marked the end of the original Cruzado plan. Despite months of a supposed price and wage freeze, 1986 inflation was 145.3%, most of it clocked through illegal price rises in the last months of the plan, when it was clear to the private sector that the economy remained overheated, public finances remained out of control, and the statutory price level was unsustainable. In addition to this, the substantial rise in consumption and some measure of real appreciation in the latter part of the year conspired to disrupt the one thing the previous governments had achieved: external adjustment. The current account went from near balance in 1984 and 1985 to a deficit in excess of US$ 5 billion in 1986. In the international environment of the mid-1980s, voluntary inflows were simply not available to finance this increase, and the government was forced to declare a 'technical moratorium' on 20 February 1987, which suspended interest payments on US$ 67 billion of foreign bank debt (IDB, 1988, p.361).

The failure of the Cruzado plan ushered in an era of despondency in Brazilian macroeconomic policy. This was characterised by the uneasy co-existence between the knowledge that there was no political will to tackle the underlying causes of inflation - notably the fiscal imbalance - and the need to be publicly seen to be doing something about escalating price rises. Two other 'plans' were implemented under this administration: the "Plan of Macroeconomic Control", otherwise known as either "Novo Cruzado" or 'Plano Bresser', was launched in June 1987, under Minister Bresser Pereira. The

centrepiece of the plan was once again a wage and price freeze, this time for a maximum of 90 days. In order to prevent a further deterioration of the balance of payments position, the cruzado was immediately devalued by 10.56%. To prevent a continuing budgetary crisis in the state owned companies, whose prices had been kept artificially low to reduce private sector price rises, there were one-off substantial rises in electricity, telephone, steel and petrol costs.

The combination of these relative price adjustments, substantially raising input costs across the economy, with a freeze imposed on private sector prices was not perceived as a particularly credible strategy. Not even by the government itself, which announced at the outset that after the removal of the freeze, "wages will be readjusted monthly, according to the average inflation in the three preceding months." (Folha de São Paulo, 13/06/87, p.1). As a result, the plan "achieved few successes and, by year-end, had been essentially abandoned."(IDB, 1988, p.363). Inflation was over 14% per month in December, and kept rising in 1988. For 1987 as a whole, it reached almost 230%. Despite the rhetoric against the public deficit, this was not substantially curtailed and remained above 10% of GDP. In particular, Congress awarded substantial pay rises across the public sector, leading the IDB to comment openly that: "The most pressing problem was posed by the Federal Government wage bill, which was projected to exceed non-earmarked current revenue."(IDB, op. cit.).

This failure to control public expenditure and to bring it in line with revenues continued through 1988. No plans were attempted this year, partly because all political attention was focused on the drafting of a new Constitution. As Table 1 indicates, public spending continued to rise, driven mostly by wages and debt financing costs, both of which were heavily indexed and not discretionary. The fiscal deficit almost doubled, and inflation almost tripled. Domestic demand fell, led by investment cuts due to growing uncertainty. This led to the first GDP contraction since 1983, but also to a substantial recovery in the trade balance, and so to a significant current account surplus.

By December 1988, monthly inflation reached 28%. With the Constitution completed by October, Sarney's third Finance Minister, Mailson da Nóbrega, announced the third price and wage freeze in January 1989. This was titled the 'Summer Plan', a virtual repeat of the Plano Bresser, but with an even shorter intended period for the freeze: six weeks. Like

its predecessor, it included a devaluation and hikes in public tariffs. Like the Cruzado of 1986, it replaced a beleaguered currency by cutting three zeros off it, and calling it the New Cruzado. It too insisted that government expenditures would be cut. Ministries were abolished, public employees were threatened with redundancy and a privatization plan was drawn up.

And once again it came to naught. Once again it was an election year - presidential this time - and both the President and Congress were exceedingly hesitant to reduce the expenditures which traditionally provide them with electoral leverage. There was no mass firing of public employees, and not a single company was privatised in 1989. The fiscal deficit neared a quarter of GDP and in June the IBGE was measuring inflation rates above 20% per month again. For 1989 as a whole, the index reached 1,287% and it continued to accelerate into the first quarter of 1990, prior to the swearing in of the new government, on March 15.

On March 16, the new President, Mr Fernando Collor de Mello, launched the last economic plan of the decade. The Collor plan was different from its predecessors. Prices, wages and rents were not frozen. Instead, its centrepiece was a freeze of financial assets intended to drain liquidity from the economy and sustain the new currency - which was renamed the cruzeiro. Bank account holders were forbidden from withdrawing more than Cr$ 50,000 (US$ 1277) from their current accounts, or 20% of any funds held in overnight or other interest bearing deposits. (Financial Times, 19/3/90). The remaining balance - most of the stock of financial wealth in the economy - would be released in up to eighteen months when, it was hoped, cuts in government spending and new taxes would have balanced the budget, and the Cruzeiro would be a stable currency.

The plan did include attempts to streamline the federal administration, to initiate a serious privatization programme and to raise tax revenues. New taxes were imposed on large fortunes and on inheritances, and there were efforts to improve tax collection across the board. On the expenditure side too, the government made deeper cuts than had been attempted under any of the previous plans. As a result, the IDB figures presented in Table 1 indicate a reduction in the deficit of the order of 10 percentage points of GDP.

But this did not suffice to eliminate inflation. By exploiting loopholes in the legislation

governing 'exceptions' to the asset freeze, most companies and individuals holding large balances had managed to release them by July. As a result, "not only was the economy remonetized more rapidly than had been intended but also the recovery of liquidity was extremely uneven." (IDB, 1991, p.49). In the absence of a price freeze, and in light of a severe contraction in output, caused by the earlier liquidity squeeze and by the government expenditure cuts, the re-expansion of the money supply led to a sharp readjustment in the price level, which quickly became inertial again. Annual inflation in 1990 was very nearly 3,000%, the largest in Brazilian history by a factor of more than two. Compounding the failure, the initial severity of the wealth shock was such that output plummeted by 4.6% and real wages in manufacturing by some 20% over the year.

The end of the decade, therefore, saw the country back where it had started the 1980s: in a stagflationary scenario. The next chapter describes the evolution of inequality and poverty during the period, and some of the trends and fluctuations appear to be related to the macroeconomic history sketched above. Chapter 8 examines these links more formally, as a complement to the more standard inequality decomposition analyses it contains.

CHAPTER 7

GROWING APART: INEQUALITY AND POVERTY TRENDS IN BRAZIL IN THE 1980s

Abstract: This chapter reports on a detailed investigation into the evolution of inequality and poverty in Brazil during the 1980s, using a large repeated cross-section household survey data set. Summary statistics, decile means and decile shares are presented for every year, as well as different scalar inequality and poverty measures. First and second order stochastic dominance results are reported for a number of distributions, and statistical tests are performed to infer population dominance, generating robust welfare and inequality comparisons. Analogously, mixed stochastic dominance is used in poverty comparisons. Sensitivity of the measures and of the observed trends to the equivalence scale used is investigated. The main finding is that inequality worsened unambiguously, although not monotonically, during the 1980s. Poverty also rose, despite some growth in mean reported incomes, but its behaviour was more cyclical than that of inequality.

1) Introduction

This chapter focuses on the application of appropriate and up-to-date concepts and techniques to forming judgements about the evolution of inequality and poverty, and to making welfare comparisons over time. It aims to present a detailed picture of what happened to the distribution of income in Brazil during the 1980s. Chapter 8 will then discuss some possible explanations for the trends, by means of standard inequality decompositions and some simple correlation and regression analysis based on the behaviour of macroeconomic aggregates.

Brazil's pronounced inequality, combined with the recent economic history described in Chapter 6, make it virtually unique as a case study for the behaviour of income distribution in the 1980s. Not surprisingly then, it has been the subject of a large literature, at least since the 1970s. The World Bank's (1993b) Social Indicators of Development 1993 alone lists 95 references on inequality and poverty in Brazil.[1] It is not my intention here to survey these works, but some of the more recent pieces cover the time period of this chapter, at least in part, and have been helpful to the formulation of my approach and as references for comparing results.

Barros, Mendonça and Rocha (1993) is probably closest in scope to these chapters, although the emphasis on welfare dominance, the poverty aggregation procedures, the inequality decomposition analysis and the way in which I investigate links to the macroeconomic environment are new. Fox (1990) discusses the impacts of some macroeconomic trends on poverty and employment levels over the period 1970-1987, and some of her analysis draws on published summary tables of the PNAD, the data set used here in its complete form. Fox and Morley (1991) extend that analysis and apply a simple macro model to Brazil. Their paper contains a number of predictions for aggregate variables for the 1990s, and its focus is very different from mine. Hoffman (1989) contains a careful empirical study of the personal and household income distributions until 1986. It appeared as a chapter in an important volume on the subject, edited by Sedlacek and Barros (1989). Pfefferman and Webb (1983) use expenditure survey data from

[1] Some of these references go a long way back. The list includes books, book chapters, journal articles and working papers; written in English, Portuguese and Spanish.

ENDEF[2] to argue that poverty declined in the 1970s and perhaps more intensely than suggested by the income data. That poverty decline is broadly corroborated by Tolosa (1991), who also uses more recent data to obtain poverty trends in the 1980s. Thomas (1987) also uses ENDEF data and the associated regional price indices, to look at regional and urban-rural differences in the incidence of poverty in the 1970s.

Most recently, Amadeo et al (1994) use PNAD data for the 1980s to investigate trends in the composition, quantity and 'quality' of employment in Brazil. They include a brief discussion of the impacts of labour force changes on income distribution, but this is decidedly not their main focus. Jatobá (1995) also focuses on labour force trends and their implications for poverty. These papers differ substantially amongst themselves, and so differ from this one in different ways. The main objective of this chapter is to provide a detailed, comprehensive description of the evolution of the distribution of income in Brazil during the 1980s, using the largest available data set and the best-practice techniques of inequality analysis and intertemporal welfare comparison. It relies heavily on stochastic dominance results, and I believe that it fills a gap in the existing literature.

The chapter is organized as follows. Section 2 discusses some basic concepts and the tools of distributional analysis, including the scalar measures used and stochastic dominance. Section 3 describes the data set, which consists of nine years of the repeated cross-section household survey PNAD, produced by the Brazilian Statistical Institute (IBGE), and discusses some of its shortcomings. Section 4 analyses the changes in the distribution of gross household income per capita, and hence in inequality, using standard tools: Pen parades, Lorenz and Generalised Lorenz curves for looking at whole distributions, as well as summary inequality measures. Section 5 contains the results on the evolution of poverty: §5.1 describes the derivation of the chosen poverty lines, and §5.2 presents three poverty indices for different years across the decade, as well as the poverty mixed dominance comparisons. Section 6 investigates the sensitivity of the results, both on inequality and on poverty, to variations in the equivalence scale used. Section 7 concludes.

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[2] The *Estudo Nacional da Despesa Familiar* (ENDEF), or National Family Expenditure Survey, was carried out by IBGE in 1974/75, and remains Brazil's most recent nationwide expenditure survey. The *Pesquisa de Orçamentos Familiares* (POF), or Family Budget Survey, was conducted in 1987, but it covered only 11 large urban areas. See section 5 for details.

2) Concepts and Tools of Distributional Analysis.

As stated above, my objective in this chapter is to gain some insight into the evolution of the distribution of income in Brazil in the 1980s. This section contains a brief review of the main analytical concepts and tools used in the sections that follow. It is not intended as a literature survey or a comprehensive treatment of distributional analysis; for which the reader is referred to Atkinson (1983) and Cowell (1995).

Income, the distribution of which we are about to consider, is of interest ultimately as a proxy for welfare, or standard of living. The first issue confronting the empirical investigator, then, is whether it is a good proxy. Experts differ on this point and many have suggested that other variables, such as consumption expenditure, or indices which give weight to environmental and political entitlements, should replace income altogether. Sen's (1981) entitlement approach is a notable example of a conceptual challenge to income as the best measure of living standards. Others argue that consumption expenditure is a more reliable guide than current income to real living standards, either because (if capital markets work) there are theoretical reasons to see it as a better proxy for permanent income (see, e.g. Chauduri and Ravallion, 1994), or for empirical reasons to do with data reliability and reporting problems:

> "In the context of measuring welfare in LDCs, there is a very strong case in favour of using measures based on consumption rather than on income. The standard argument for consumption over income - that in view of the permanent income hypothesis, consumption is a better measure of lifetime welfare than is current income - is much weaker than arguments based on practicality and data." (Deaton, 1994, p.126)

This is not an issue to be lightly dismissed. Income reporting problems, principally at the top and bottom ends of the distribution, are known to be frequently very serious. Worryingly, Mercader (1995) finds that even in relatively high-quality data countries, such as Spain, income and expenditure can yield very different rankings over the same population. The choice of current income, rather than expenditure, in the analysis that follows is the result of a constraint on data availability. The last comprehensive national household expenditure survey conducted in Brazil is the ENDEF, of 1974-75. The POF of 1987 covers only 11 large urban areas and, because it was the only such exercise

carried out in the 1980s, it would not allow any comparisons over time in the decade, which is my principal objective. Although there are limitations to the income data set used in this chapter, it is available for every year in the relevant period and, as I will argue below, some of the problems are likely to be less severe if one is more interested in inferring trends, rather than levels of welfare.

Even if one accepts income as the variable for analysis, there is the second issue of the many different definitions of income one can use. Current income differs from permanent income, and may be given in gross or net terms. Income can come in cash or kind. Becker (1965) has urged the concept of "full" income, to include the imputed value of leisure. Atkinson and Stiglitz report as "the widely accepted 'ideal' or 'comprehensive' definition" that of Haig and Simons:

> "Personal income may be defined as the algebraic sum of (1) the market value of rights exercised in consumption and (2) the change in the value of the store of property rights between the beginning and the end of the period in question." (Simons, 1938, p.50, in Atkinson and Stiglitz, 1980, p.260).

That is the concept we are after, the ideal definition of current income, which clearly differs from permanent or lifetime income, as well as from full income. Again, this choice is not based on a value judgement, but on what is available in practice. Even so, the data discussion that follows will suggest likely deviations of our income values from the above definition, which we include here as a benchmark.

Then, there are the related issues of the income recipient and equivalent scale. In theoretical models such as those in foregoing chapters of this thesis, one can assume that all households are of the same size, and normalize it to one. But in reality, household sizes and compositions vary, and economies of scale give rise to the need for some means to compare household incomes across widely differing compositions. There is no single universally used approach, but most practitioners do use one of many existing equivalence scales to make household incomes comparable. Coulter, Cowell and Jenkins (1992b) provide a review of the main issues involved in constructing equivalence scales and discuss the sensitivity of poverty and inequality measures to the choice of equivalence scale. Once a particular equivalence scale is chosen, equivalised household income can be ascribed to each household or, as in this chapter, to each individual in the household.

In this thesis, a simple assumption about equivalence scales is made: our working definition of equivalised income is household income per capita. The income recipient is the individual. This is in line with the existing literature on Brazilian income distribution, but I discuss the implications of relaxing this assumption and varying the equivalence scale in Section 6. Any discussion of equivalence scales is postponed to that section.

Once a particular definition of income has been agreed, an equivalence scale has been adopted and the income receiving unit defined, we can turn to the distribution itself. Like many other economic entities, income (e.g. gross household income per capita), denoted by y, can be represented as a discrete or as a continuous variable. Correspondingly, the distribution of income can be represented as a vector **y**, the dimension of which is given by n, the number of income recipients in the population or sample in question, or as a distribution function $p = F(y)$, where p denotes the share of the population with incomes below y.[3] It follows that inequality measures - measures of the dispersion of such a distribution - can also be defined in discrete (summative) form, or in continuous (integral) form. We will define scalar measures in discrete form, which is the most convenient in practice, but will rely on continuous distributions when it comes to defining stochastic dominance results, in keeping with the existing literature.

Perhaps the first remarkable thing about inequality measurement is the sheer multitude of scalar measures that have been suggested. Cowell (1995) lists twelve such measures in his Appendix Table 1, namely the variance, the coefficient of variation, the range, the relative mean deviation, the logarithmic variance, the variance of logarithms, the Gini coefficient, the Atkinson class, the Dalton class, the Generalized Entropy class, the Herfindahl index and the Theil index. And these are but a few examples.

The reason why so many measures have been suggested is that they all behave differently (some pairs only slightly differently, others quite dramatically so). Properties of various measures are discussed in detail by Cowell (1995), and it would fall beyond the scope of this section to dwell on them here. However, one consequence of indices behaving

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[3] Alternatively, the distribution can be described by the density function $f(y) = dF(y)/dy$. Issues related to modelling the Brazilian density function, parametrically and non-parametrically, are not discussed in this thesis. See instead Cowell, Ferreira and Litchfield (1995b).

differently from one another, and in fact often ranking two distributions (F and F*) in opposite ways, was to somewhat damage the credibility of inequality measurement. Two complementary approaches exist to try and remedy that problem: the first is the so-called axiomatic approach, which builds up a list of desirable properties for an inequality measure to have, until the set of eligible measures is small enough. The second is oriented specifically towards distributional comparisons, and abandons the (attractive) idea of summarizing dispersion in one number. This is the stochastic dominance approach, whereby whole distributions are (partially) ranked with respect to well specified criteria, but no scalar value is attached to them.

Although many axioms have been suggested for inequality measures, I will focus here on five popular ones. Let the (general) inequality measure be denoted by I(**y**). Then consider the following axioms:

(I) *The symmetry (or anonymity) axiom* is satisfied iff for any permutation **y'** of vector **y**, I(**y**) = I(**y'**).

(II) Let $y_i > y_j$; $y_i, y_j \in \mathbf{y}$. Consider **y'**, which is obtained from **y** simply by a transfer $\delta > 0$ from y_i to y_j, such that $y_i - \delta > y_j + \delta$. *The weak transfer axiom* is satisfied iff I(**y**) > I(**y'**).

(III) For any scalar $\lambda > 0$, *the scale invariance axiom* is satisfied iff I(**y**) = I(λ**y**).

(IV) For any scalar $\lambda > 0$, *the population replication axiom* is satisfied if I(**y**) = I(**y**[λ]), where **y**[λ] is a concatenation of the vector **y**, λ times.

(V) Let **y** be partitioned into K subvectors, $\mathbf{y}_1, \mathbf{y}_2, \ldots \mathbf{y}_K$. Define $\mu(\mathbf{x})$ as the mean of any vector **x**; $I_{between} := I(\mu(\mathbf{y}_k))$; and $I_{within} := \sum^K_{k=1} w_k I(\mathbf{y}_k)$, where $w_k = s_k^{\alpha} v_k^{1-\alpha} \geq 0$, $0<\alpha<1$. s denotes income share of group k, and v denotes its population share. Then *the decomposability axiom* is satisfied iff $I(\mathbf{y}) = I_{between} + I_{within}$. [4]

Whilst there is no unanimity with regard to which axioms an ideal measure should satisfy, there has been increasing acceptance of the above set (I) - (V). Indeed, Theorem 5 (p.60) in Cowell (1995) states that any measure I(**y**) that satisfies these axioms is a member of the Generalized Entropy Class, and can thus be expressed as follows:

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[4] A weaker version of the decomposability axiom requires simply that the overall inequality measure can be represented as a function of within-group inequalities, group mean incomes, and group sample sizes (n), i.e.:
$I(\mathbf{y}) = \Phi \{I(\mathbf{y}_1), \ldots, I(\mathbf{y}_K); \mu(\mathbf{y}_1), \ldots, \mu(\mathbf{y}_K); n(\mathbf{y}_1), \ldots, n(\mathbf{y}_K)\}$.

$$G(\alpha) = \frac{1}{\alpha^2-\alpha}\left[\frac{1}{n}\sum_{i=1}^{n}\left(\frac{y_i}{\mu(y)}\right)^{\alpha}-1\right], \quad \alpha \in \mathbf{R} \qquad (1)$$

where α is a choice parameter. The Theil index is simply G(1).[5] The coefficient of variation, which is also used below, is a simple transform of another member of this class. In fact, $G(2) = 1/2\ CV^2$. The third scalar measure used below is the Gini coefficient. It does not satisfy all of the axioms above, although it does satisfy (I), (II), (III), (IV) and a weaker version of (V), where decomposability is defined only for non-overlapping partitions. Although its non-decomposability for overlapping partitions is a disadvantage of the Gini, it is such a widely used measure, that commonality and comparability with other studies was felt to justify its inclusion. It is not used in the decomposition analyses of Chapter 8, where another member of the Generalized Entropy class is introduced.

Hence, three different scalar measures of inequality are presented in Section 4: the Gini coefficient, the Theil index [G(1)] and the coefficient of variation.[6] They will provide a revealing picture of the trends and fluctuations in inequality over the decade, and one of their advantages lies in the summarizing power of a single number. Nevertheless, even the restricted set of measures that satisfy the axioms listed above can rank two distributions **y** and **y'** differently, simply because they are more sensitive to changes in different income ranges in the distribution. Some examples of this arise in Section 4, where the results are presented.

Because these indices explicitly measure different things - by virtue of the parametric choice which determines which income range they are particularly sensitive too - there is nothing 'wrong' with these ambiguities. Still, it was felt in some quarters that conflicting results from different measures weakened conclusiveness and the policy relevance of inequality analysis. These concerns gave rise to the stochastic dominance approach, pioneered in the context of income distributions by Atkinson (1970). Although it is again not my intention to survey this well known literature, it is useful to re-state the main definitions and results which the analysis in section 4 draws on.

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[5] G(0) and G(1) are the only two members of the GE class that satisfy a stronger version of the decomposability axiom, obtained by adding the requirement that $\sum w_k = 1$.

[6] Their formulae appear in Appendix B to Chapter 7.

A distribution F(y) is said to display first order stochastic dominance over another F*(y), iff:

$$F(y) \leq F^*(y) \quad \forall y \qquad \wedge \qquad F(y) < F^*(y) \quad \exists y \tag{2}$$

i.e., if its distribution function lies nowhere above and at least somewhere below that of the other. Now, as we stated above, somewhat less formally:

$$p = F(y) = \int_0^y f(x)dx \tag{3}$$

where x is the integrating notation for the income variable. The inverse function $y = F^{-1}(p)$ is known as a Pen parade. Just as the distribution function tells us what share p of the population has income lower than or equal to y, the Pen parade tells us the income level of quantile p of the population. It is a useful diagrammatic construct, which we use below in common with much of the literature. First order stochastic dominance is often also defined in these terms:

$$F^{-1}(p) \geq F^{*-1}(p) \quad \forall p \qquad \wedge \qquad F^{-1}(p) > F^{*-1}(p) \quad \exists p \tag{4}$$

i.e., if the Pen parade corresponding to one distribution lies nowhere below and at least somewhere above that of another, it has first order stochastic dominance over it.

Now let us define the deficit curve $G(y_k)$ as follows:

$$G(y_k) = \int_0^{y_k} F(y)dy \tag{5}$$

A distribution F(y) displays second order stochastic dominance over another F*(y), iff:

$$G(y_k) \leq G^*(y_k) \quad \forall y_k \qquad \wedge \qquad G(y_k) < G^*(y_k) \quad \exists y_k \tag{6}$$

Again, analogously to the first order case, the result can be expressed in terms of a dual function, the Generalized Lorenz Curve, defined as:

$$GL(p) = \int_0^p F^{-1}(\pi)d\pi \tag{7}$$

where π is the integrating notation for p, the population share variable. Changing the variable of integration yields a perhaps more familiar definition:

$$GL(p) = \int_0^{y_k} y dF(y) \tag{8}$$

which immediately reveals that the height of the curve at percentile p is given by the mean of the distribution until p. Now because the Generalized Lorenz is a dual - rather than the inverse - function of the deficit curve, the two can not be used interchangeably in every circumstance. Fortunately, as discussed by Atkinson and Bourguignon (1989) and Howes (1993a), second order stochastic dominance until income level y ($FD_2F^*(y)$) implies and is implied by Generalized Lorenz dominance until percentile p ($FD_LF^*(p)$) if $p = F(y) \leq F^*(y)$. This holds automatically for comparisons of complete distributions, such as those discussed in this section and in Section 4, since $p = F(y) = F^*(y) = 1$. I hence refer to the two forms of dominance over complete distributions interchangeably below, and return to the issue only when discussing dominance in the context of poverty in Section 5.

So F(y) displays Generalized Lorenz dominance over (second order dominates) F*(y) iff:

$$GL(p) \geq GL^*(p) \quad \forall p \quad \wedge \quad GL(p) > GL^*(p) \quad \exists p \tag{9}$$

It follows from these definitions that first order stochastic dominance is a stronger requirement, which implies (but is not implied by) second order stochastic dominance.

Finally, there is a special case of second order stochastic dominance which is particularly useful in the study of inequality, in that it compares mean-normalized distributions. A distribution F(y) is said to display Lorenz dominance (mean-normalized second order stochastic dominance) over another F*(y) iff:

$$L(p) \geq L^*(p) \quad \forall p \quad \wedge \quad L(p) > L^*(p) \quad \exists p \tag{10}$$

where:

$$L(p) = \frac{1}{\mu(y)} \int_0^p F^{-1}(\pi) d\pi \qquad (11)$$

is a Lorenz curve for the distribution given by F(y).

The usefulness of stochastic dominance analysis derives from the existence of a set of rather powerful (and well-known) theorems which establish welfare and inequality comparisons across distributions. The first states that if (2) - or (4) - holds, then social welfare enjoyed in F(y) is unambiguously higher than that in F*(y), as measured by any individualistic, additive, increasing and symmetric social welfare function. The theorem is proved by Saposnik (1981, 1983), and discussed again by Howes (1993a) and Cowell (1995). The second theorem states that if (6) - or (9) - holds, then social welfare enjoyed in F(y) is unambiguously higher than that in F*(y), as measured by any individualistic, additive increasing, symmetric and strictly concave social welfare function. This theorem is due to Shorrocks (1983), who also introduced the Generalized Lorenz curve.

The third theorem refers to mean-normalized second order, or Lorenz dominance. Formulated in welfare terms[7], it simply restates Shorrocks's theorem for the (very) special case of two distributions with exactly the same mean. It is more widely used, however, to compare inequality - rather than welfare - across any two distributions. As Howes (1993a) points out, welfare, inequality and poverty can be studied under one common general framework, but with inequality results being drawn by abstracting from the mean by normalization, and poverty results by considering a censored distribution, cut off at the poverty line. In inequality terms, this third theorem states that if (10) holds, then inequality is unambiguously higher in F*(y) than in F(y), as measured by any inequality measure that satisfies axioms (I) and (II) above. This theorem is due to Atkinson (1970), who drew on analogies with the financial risk literature, including Hadar and Russell (1969) and Rothschild and Stiglitz (1970). Although I will report the changes in scalar inequality measures as discussed above, all three of these theorems will be heavily relied upon in establishing our intertemporal comparisons of the income distribution in Brazil, in Section 4.

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[7] As in Cowell (1995, p.42).

3) The Data Set.

The data sets are the *Pesquisa Nacional por Amostra de Domicílios* (PNAD) for 1981-1990, produced by the *Instituto Brasileiro de Geografia e Estatística* (IBGE). Data were collected each year from a representative national sample of households, selected according to a three-level multi-stage sampling procedure. This is based on a successive selection of municipalities, census sectors and individual households. All capital municipalities, metropolitan municipalities, municipalities with high populations and those 'with a special economic or social characteristic' are automatically selected. Other municipalities are grouped according to size, and from each group at least two are randomly selected, with sampling probabilities based on populations drawn from the most recent census. For each municipality selected in the first stage, census sectors are identified and randomly sampled, with sample weights again determined by population proportions reported in the census. Finally, within each selected census sector, individual households are sampled. The total sample size varies each year, from a minimum of 286,000 (in 1986) to a maximum of 517,000 individuals (in 1985)[8]. A list of exact sample sizes on which our analysis is based is presented below in Table 1.

Table 1: PNAD Sample Sizes in the 1980s.

year	Number of Individuals*	Number of Households*
1981	475,290	102,211
1983	502,944	112,015
1984	508,231	114,795
1985	517,281	118,085
1986	286,107	67,047
1987	294,708	67,509
1988	291,725	67,507
1989	303,013	71,070
1990	299,756	71,522

* The number of individuals gives the sample size for the analysis in this chapter, where the income recipient is the individual. The number of households gives the sample size for some of the decomposition analyses in Chapter 8, and is included here for general information.

[8] The sampling method embodies a natural growth in the sample size of the survey, reflecting the underlying population growth rate. There was a sharp break in 1986, when the sample size was reduced for cost-related reasons, with special care paid to maintaining precision. See IBGE (1991).

The survey reports annually on a range of variables which form the basic data set, common to every year, with only minor exceptions. Questions are asked on subjects pertaining to the household and to individuals within the household. Information is recorded on the geographic location of the household; characteristics of the dwelling; household size; relationships between individuals in the household; activities of individuals; income from labour, specified in up to two separate jobs and in total; income from transfers; income from other sources, such as land rents and capital incomes; occupation and other labour characteristics; age; gender; education; colour and literacy. Population weights, based on the 1980 Census are also included. Appendix A to Chapter 7 includes a copy of the original PNAD questionnaire for 1989, as well as a full list of variables available on the original data tapes, briefly described in English.

In addition to this core set of indicators, a further supplementary survey was conducted in some years. A table of topics for these surveys is listed below in table 2.

Table 2: Supplementary Surveys

Year	Subject
1981	Health
1982	Education
1983	Labour
1984	Fertility
1985	Youth
1986	-
1987	-
1988	Social Attitudes
1989	-
1990	-

These chapters focus on income, although other variables, such as household size, individual age, gender and education, are used in the analysis. Income is gross monthly household income per capita (from all sources) and the income receiver is the individual. In practical terms, this means that our income vector consists of variable v410 - total monthly income of the household - divided by household size h, entered h times. Note that variable v410 is not the direct response to any question asked to a member of the

household under the household section of the questionnaire (section 2). It is rather the summation across all individuals aged 10 or above, of variable v602 - total monthly income from all sources for the individual. Variable v602 in turn is also not a direct response variable. It is the sum of variables v537, v538, v549, v550, v578, v579, v580, v581 and v582. These income variables are listed separately, in Table 3 below, for ease of reference.

Table 3: Key Income Variables in the PNAD Data Set

a) variables pertaining to individuals

v537	gross cash income from main occupation	
v538	income in kind from main occupation	
v549	gross cash income from second main occupation	
v550	income in kind from second main occupation	
v578	value of retirement pension received	
v579	value of other occupational pensions received	
v580	value of 'abono permanente' received	
v581	value of rental income	
v582	value of any other incomes not falling under any of the above categories	
v600	income from main occupation	(v537 + v538)
v601	income from labour	(v537 + v538 + v549 + v550)
v602	total income from all sources	

b) variables pertaining to the household

v410	Total household monthly income

The interviews using the questionnaire in Appendix A were carried out face-to-face in the last quarter of every year. Labour occupational status questions were asked with respect to a reference week, and income questions with respect to a reference month. This was September in every year except 1981, when it was October. All data for 1982 is excluded on advice from IBGE, because in that year the survey was carried out with a 12-week reference period. This methodological divergence from other years was reflected in the collected data, hampering intertemporal comparability. See IBGE (1993, p.10). The small proportion of households with missing income data were excluded from the sample. These constituted approximately 1% of the sample in each year; e.g. 0.80% in 1981, 0.99% in

1985 and 1.34% in 1990.[9]

For a country with very high inflation, such as Brazil in the 1980s, the importance of having time-series income data expressed in real terms is obvious. The unit in which the data could be expressed might have been the local currency, an alternative unit such as the minimum wage, or the US dollar. One of the problems with the local currency is that it changed name and unit of account three times in the relevant period[10]. Another problem is that inflation was so high that it is difficult to associate real values to the monetary values of previous periods.

The minimum wage is often used as a unit for comparing incomes over time in Brazil. But its value in real terms was far from constant during the period, detracting from its usefulness. For these reasons, and for ease of international comparability, the US dollar was chosen as the income unit. The last year in the series was chosen as the base year, for ease of current understanding of the values.

Nominal Brazilian currencies were converted to constant 1990 US dollars according to the following procedure. First, local currencies were converted into 1990 Brazilian Cruzeiros using the CPI deflator, the *INPC* (IBGE, 1993); second, the Cruzeiro series was converted to 1990 US dollars using the exchange rate for the interview month in 1990. The rate used was the period average market exchange rate for September 1990, as reported in the rf series of the IMF International Financial Statistics. This procedure was compared to the alternative whereby local currencies were converted directly to the current dollar values each September, and the nominal US dollar series was subsequently deflated using the US CPI. The former was chosen on the grounds that it was considerably less susceptible to error from inappropriate choices of exchange rate than the alternative procedure. This was found to have a serious impact on intertemporal comparability of mean incomes, and was exacerbated by very high rates of inflation. The two procedures are described in greater detail in the data documentation mimeo by Cowell, Ferreira and Litchfield (1995a).

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[9] The sample sizes reported in Table 1 above are after these exclusions.

[10] The Brazilian currency was the Cruzeiro until 1986, the Cruzado from 1986 to 1988, and the Novo Cruzado from 1988 until March 1990, when it was again renamed Cruzeiro.

After downloading and decoding the tapes, a number of consistency checks were carried out. In terms of discrepancies between data entry on tape and the description in the manuals, the only variable that was found to be entered wrongly was the radio ownership dummy - responses were coded as 2 and 4, instead of 1 and 3 as the manual states. For the handful of observations checked every year, the summation of incomes as described in table 3 above was correct. A general check of our own data handling was performed by comparing our results with those published by IBGE (1993), which reports average incomes, Gini coefficients and decile shares for all years 1981 to 1990, calculated from the PNAD.

Whilst our estimates from the micro-data match very closely the official estimates of inequality and income distribution, our estimates of average incomes are at variance. We investigated the reason for this divergence as our 'first problem'. Furthermore, both our estimates of average incomes and those of the IBGE are very different from aggregate figures such as GNP per capita in the World Development Reports, or GDP per capita as reported by the IDB (see Table 6-1). This is the 'second problem'.

With regard to the first problem, we established that discrepancies between our estimates and those of IBGE are due to differences in the (in their case implicit) equivalence scale used. IBGE (1993) presents two series of average incomes:

1) average income per individual aged 10 or more years, with income;
2) average income per individual aged 10 or more years, with or without income.

The first definition therefore ignores not only children, but also 'adult' individuals who themselves have no income, but live in households where there is an income. The second definition includes the latter but continues to disregard children. Table 4 compares estimates from the micro data with the official reported figures, and also with our preferred definition of income and sample. The fact that the means for the definitions 1 and 2 are almost identical, and that those for definitions 3 and 4 are also very close is reassuring. It signifies that a) the data set is almost identical to the one used by IBGE (differences are due to a small number of observations being lost in the decoding and downloading of the tapes), and b) the calculation methodologies can replicate those of IBGE.

Table 4: Comparison of estimates of average incomes, 1990 (Cruzeiros).

Definition 1	Definition 2	Definition 3	Definition 4	Definition 5
27 016	27 025	15 978	16 055	12 406

Definitions:

1: IBGE estimate of average income per individual aged 10 or more with income.

2: Our estimate from micro-data of average income per individual aged 10 or more with income.

3: IBGE estimate of average income per individual aged 10 or more with or without income.

4: Our estimate of average income per individual aged 10 or more with or without income.

5: Our estimate of average household income per capita across all individuals.

Note that differences between definitions 1 and 3 (and hence between 2 and 4) are due to the following: definition 1 excludes all individuals with zero income, regardless of their household income), whereas definition 3 includes those who are older than ten. This implies that the mean in definition 3 is income per capita (aged ≥ 10), whereas definition 1 is income per income earner.[11]

On that basis we can ignore definitions 1 and 2. Furthermore, definition 5 (average household income per capita across all individuals) was deemed preferable to definitions 3 and 4, because it includes all children, regardless of their ages, since children do consume. It was felt that to exclude them artificially and unjustifiably inflated the average income statistic. It could be seen as a very crude way of taking household scale economies into account, but it is not presented as such by the IBGE, and I prefer to adopt income *per capita* as a working definition, and to return to the issue of equivalence scales explicitly in Section 6.

[11] This is why the IBGE revised (some but not all) their estimates from definition 1 to definition 3, in IBGE (1993).

The second problem concerns discrepancies between estimates based on the household survey and statistics reported in, for example, the World Development Reports. For 1990, mean monthly income by our chosen definition is Cr$ 12,406, or US$ 164. This gives an annual income of US$ 1968. The WDR 1992 reports Brazil's 1990 GNP per capita as US$ 2680. This represents a deviation of 36%, and the equivalent figures for other years are not substantially different.

This is an example of the general problem of comparability between national accounts based and household survey based statistics, common to many countries. National accounts include such items as public expenditure on health and education, which are very difficult to measure and account for in a household survey. In the case of Brazil, it has been argued that the level discrepancies (which are large) arise primarily out of under-reporting of capital and other non-labour incomes. It has also been suggested that the importance of these income sources increases monotonically with income, thus causing PNAD-based studies to underestimate income inequality (see Lluch, 1982).

Hence, while the 'first problem' of comparability with IBGE published data has been satisfactorily accounted for, the second issue is a substantial one. Practitioners of distributional analysis seem to regard discrepancies with national accounts data as a regrettable but inevitable reality of household survey data. Lluch's work does suggest that the under-reporting of income which is one of the causes of these discrepancies is not uniform across the distribution of income in Brazil, and that it tends to underestimate the incomes of the rich more severely than those of the poor. Unfortunately, given our data set, little can be done other than to note this issue and bear it in mind when interpreting the results.

There are four additional reasons to suspect mis-reporting of one kind or another. First, still on the issue of income from capital, it is clear from the questionnaire in Appendix A that any such income should be reported under item 5 in question 28, the last of the form. It would therefore figure in variable v582, whereas rental income would figure under v581. The fact that capital income is lumped with benefit income in the last question of the survey, after the detailed consideration given to labour incomes earlier, is unlikely to counteract the natural tendency for many people to under-report interest, dividend, or own profit incomes.

Second, even if capital incomes were correctly reported, and so were benefit incomes, one could still not interpret v582 as 'capital income', because there are state transfers which are not listed explicitly under items 1, 2 and 3 of question 28, and which should hence be lumped together with capital incomes in item 5, under 'all other earnings'. One example is the incipient unemployment insurance programme, which was initiated in 1986 and benefitted 1.4 million unemployed workers in 1989 (see Barros et al, 1993).

Third, it is doubtful that interviewers across Brazil were sufficiently careful to instruct respondents who own small businesses, whether formal or informal, on the need to separate the labour component of their income from that which is return to capital. Given the structure and emphasis of the questionnaire, it is reasonable to expect that most of this income will have simply been reported as labour income. Anyone knowing Brazil's multitude of shops, stalls and other family owned businesses of all descriptions is unlikely to be prepared to regard this problem as negligible in terms of biasing the data on the composition of income by source.

Fourth, although the questionnaire does ask explicitly for a value associated with any income in kind, some scepticism is most probably justified as to the accuracy with which respondents are likely to have valued their income, say, in own agricultural produce in subsistence activities in rural areas, or in imputed rent for live-in domestic servants. While it is possible to be reasonably confident that this will affect the reported incomes of the poor to a greater extent than those of the rich, it is difficult ex-ante to predict in which direction it would bias them. The fact that respondents may not know the exact market prices of their income in kind does not pre-determine whether they will under- (or over-) estimate it. Ex-post, however, the extremely low incomes reported for the poorest households (see Section 4 below), incompatible with survival for any length of time, lead one to suspect that under-reporting of income in kind by the poor may be more common than over-reporting.[12]

Given all of these problems, it is appropriate at this point to re-emphasize that the main

[12] Note, however, that these are current monthly incomes, so that some very low values may be explained by idiosyncratic shocks. These very low values would be a source of greater concern if the data purported to represent some measure of permanent income.

objective of these chapters is to gain insight into the evolution of the income distribution over the decade. They aim to provide a comprehensive analysis of the trends in inequality, based on the best available data and the most appropriate techniques. The existing literature, briefly described in the introduction, leaves no doubt that the PNAD is the best available data set. And it had, to the best of my knowledge, not previously been subjected to such a detailed scrutiny, in particular as regards the use of stochastic dominance analysis.

The maintained hypothesis on which this analysis is based, then, is that there is no reason for the profile of mis-reporting of capital income (mostly by the rich) and of income in kind and/or own produce (mostly by the poor) to have changed very much over the decade, so that even if one could query exact values of any of the scalar measures, inter-distributional comparisons should largely be valid.

The problems with what is actually captured by the questions relating to income in the PNAD questionnaire and their impact on the interpretation of the data are not slight, and it was my intention to highlight them above. Nevertheless, the point made in the last paragraph appears sufficient to warrant carrying out the intertemporal comparisons presented below. In this way, this work seeks to avoid, on the one hand, the danger of data carelessness, and on the other "the danger of falling prey to a kind of nihilism [which] takes the form of noting, quite legitimately, a difficulty of some sort, and then constructing from it a picture of total disaster" (Sen, 1973, p.78).

For more detail on the sampling procedure, see IBGE (1991). For a complete report on the decoding and verification methodology, refer to Cowell, Ferreira and Litchfield (1995a).

4) Inequality in Brazil, 1981-1990.

This section contains the main results relating to inequality trends and the evolution of the Brazilian income distribution in the 1980s. Summary statistics for the income distributions of each comparable year over the decade are shown below in Table 5. The table illustrates two key features of the distribution. The first is the difference between mean and median income. In each year, median income was only approximately half the mean. This

indicates that the distribution of income was extremely skewed to the right, with 50% of the population receiving incomes less than about half of the arithmetic mean.

Table 5 also suggests a 14.7% growth in mean monthly incomes between 1981 and 1990. This is clearly at odds with the picture of stagnation that emerges from the GDP per capita figures in Table 6-1, where 1990 growth over 1981 is -0.8%. This is a further consequence of the general problem of comparability between national accounts based and household survey based statistics, to which I alluded in Section 3. The usual practice in these cases seems to be to rely more heavily on the national accounts data for the behaviour of income aggregates, while using the survey data to obtain a lower bound estimate of inequality.

In this specific instance, a plausible hypothesis to explain the growth disparity is that there might have been a shift in the composition of income towards formal labour earnings - which are more accurately reported - and away from other sources more commonly understated. Tentative backing for this conjecture comes from the fall in open unemployment over the decade (see Table 6-1), as well as from the detailed labour market analysis by Amadeo et al (1994), who find that: "in conclusion... work relations in Brazil became slightly more formal in the 1980s." (p.14). While I return to this disparity in the conclusions, it would be inappropriate to ignore any feature of the survey data in the analysis below. The welfare analysis that follows naturally incorporates the growth in mean reported incomes apparent in Table 5, but the reader should bear in mind that any results on welfare changes are therefore upper bound estimates.

The second key feature of Table 5 is the growth in inequality over the decade, as demonstrated by the three summary measures, the Theil index, the Gini coefficient and the coefficient of variation (CV). Between 1981 and 1990 the Theil index rose by fifteen percent, the Gini coefficient increased by more than five percent, and the CV increased by nearly twenty-three percent. However, this rise in inequality was not monotonic over the period. Both the Theil index and the Gini rose every year from the previous one, except in 1984, 1986 and 1990. The CV also fell in 1984 and 1990, but it rose in 1986, falling the next year, and then rising almost to its 1986 level by 1990. The differing behaviour of the measures in 1986 arises from their sensitivity to incomes in different ranges of the distribution. The Theil index is more sensitive to low incomes, the Gini to

Table 5: Brazil 1981-1990: Summary Statistics

	1981	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**
Mean Income	143	126	125	150	213	166	166	196	164
Median Income	75	64	64	74	110	84	79	88	79
Theil index	0.647	0.676	0.653	0.697	0.694	0.710	0.750	0.796	0.745
Gini coefficient	0.574	0.584	0.577	0.589	0.581	0.592	0.609	0.618	0.606
Coefficient of Variation	1.635	1.743	1.635	1.804	2.084	1.891	1.869	2.154	2.009

Note: all currency units in 1990 US $

incomes in the middle of the distribution, and the CV is more sensitive to top incomes.

Despite this observation, the three measures present a remarkably coherent picture. First, there was an unambiguous tendency for income inequality to rise in Brazil during the decade. All three measures increased substantially during the recession of 1981-83, and although they fell with the resumption of growth in 1984, they soon resumed their upward trend, which was unchecked until all three measures peaked in 1989, except for the aforementioned falls in 1986-87.

Second, 1986 was an atypical year, in that both the Theil index and the Gini fell, indicating falling inequality with respect to the bottom of the distribution. The sharp rise in the CV suggests a greater dispersion amongst higher incomes. These changes go against the general trend and are almost surely due to the effects of the Cruzado Plan, which was introduced in February 1986 (see Chapter 6). This plan lowered inflation substantially, impacting positively upon those least able to protect their incomes against the inflation tax.[13] Although end-of-year inflation was 145.3% (still much lower than either 1985 or 1987 rates), it would have been quite a bit less in September, the PNAD reference month for incomes. In addition to lower inflation, the lower inequality amongst the poor in 1986 may also reflect the accumulated effect of three years of growth. The fall in all three inequality measures in 1990, albeit to levels still much higher than the decade average - and indeed than any year up to 1987 - is also connected with a severe, if short-lived, reduction in inflation in the second and third quarters.

The behaviour of mean incomes per decile sheds further light on the remarkably consistent time paths of the inequality measures (see Table 6)[14]. The data shows that although overall average income rose between 1981 and 1990, the average incomes of the poorest 30% fell. The top ten percent gained the most, with average income rising by roughly 20 percent, whilst the middle groups at worst stood still, and the poorest decile lost by almost ten percent.

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[13] This effect is at least partially captured by the real income data, to the extent that nominal returns on financial assets and/or capital gains are reported as nominal income by those to whom they accrue.

[14] Decile groupings were used for reporting income shares and means, whilst all graphs and dominance results were generated using percentiles.

Table 6: Brazil 1981-1990. Mean incomes per decile.

Decile	1981	1983	1984	1985	1986	1987	1988	1989	1990
1	13.92	12.45	12.88	13.85	20.46	13.99	12.35	14.29	12.65
2	26.32	22.52	23.45	26.02	38.36	27.31	25.26	29.09	24.96
3	37.47	37.75	32.61	37.16	55.40	40.13	37.39	42.14	37.12
4	50.29	42.55	43.29	50.17	73.73	54.94	51.22	57.76	50.91
5	65.33	55.46	55.89	65.27	96.10	73.09	68.61	77.57	68.81
6	84.67	72.21	72.76	85.80	125.29	96.40	91.20	104.48	90.82
7	111.67	96.60	96.41	114.46	164.71	128.37	122.31	142.42	122.52
8	153.72	135.23	133.16	159.17	225.87	177.48	171.07	204.42	173.10
9	237.07	213.58	207.17	248.60	349.03	275.05	273.07	321.99	274.27
10	644.46	581.29	570.87	702.14	981.90	778.20	804.44	968.85	787.16
top 1%	1692.51	1578.79	1487.34	1949.80	2839.39	2242.95	2285.66	2936.67	2236.12

Note: all incomes are in 1990 US $

The recession caused mean incomes for all deciles (but the third) to fall between 1981 and 1983. From 1983 to 1984 there was equalizing growth, with mean incomes for the bottom six deciles (again except the third) rising and those of the top four falling. This is perfectly in line with the fall of all three inequality measures in Table 6 and, indeed, with the fact that 1984 Lorenz dominates 1983, as we shall see below. As growth accelerates, all decile means are higher in 1985 than in 1984. Between 1985 and 1986, incomes for all groups again increased significantly, although not uniformly. This reflects not only the large GDP growth rates of 1985 and 1986, but also the aforementioned redistributive effect of falling inflation. The mean incomes of the poor and middle groups grew proportionately more than the mean of the rich[15], which confirms the picture obtained from falls in the Theil and Gini. Between 1986 and 1987 all ten decile mean incomes fell, but the mean incomes of the poor and middle groups fell by proportionately more than those of the rich[16].

The gains that had accrued to all groups from 1984 to 1986 were eroded almost entirely by 1988 for the lowest three deciles. By the end of the period, their mean incomes had fallen to below their 1981 levels, whilst the next three deciles were little better off.

Further insight may be gained by examining the income shares of different deciles of the distribution. This abstracts from changes in the overall mean, to look exclusively at inequality. Table 7 below shows shares of total income accruing to each decile. Between 1981 and 1990, the shares of all but the richest 20% fell, and these gained chiefly at the expense of the poorest groups. The poorest decile lost 20% of its original share of total income, the fifth decile lost nine percent of its original share, and the richest gained by almost six percent.

Again we see that the recession early in the decade was inequality-augmenting, as deciles 2 to 8 lost income share to deciles 9 and 10.[17] Between 1983 and 1984, shares of deciles

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[15] Between 1985 and 1986 average income of decile 1 rose by 48%, that of decile 5 by 47%, and that of decile 10 by 40%.

[16] Between 1986 and 1987 average income of decile 1 fell by 31%, that of decile 5 fell by 24%, and that of decile 10 fell by 21%.

[17] Although there was a 2% increase in the share of the poorest decile.

Table 7: Brazil 1981-1990. Income Shares by Decile.

	1981	1983	1984	1985	1986	1987	1988	1989	1990
Decile									
1	0.97	0.99	1.03	0.92	0.96	0.84	0.70	0.73	0.77
2	1.85	1.78	1.88	1.73	1.80	1.64	1.52	1.48	1.52
3	2.63	2.51	2.61	2.48	2.60	2.41	2.26	2.15	2.26
4	3.53	3.37	3.47	3.33	3.46	3.30	3.09	2.94	3.10
5	4.59	4.39	4.48	4.35	4.51	4.39	4.14	3.95	4.19
6	5.94	5.71	5.83	5.71	5.88	5.79	5.50	5.32	5.53
7	7.84	7.64	7.72	7.62	7.73	7.71	7.38	7.25	7.46
8	10.78	10.70	10.67	10.59	10.60	10.66	10.35	10.41	10.54
9	16.64	16.90	16.59	16.54	16.38	16.52	16.48	16.40	16.70
10	45.23	46.00	45.72	46.73	46.08	46.74	48.54	49.35	47.93

1 to 7 rose at the expense of the top three deciles. This was partly reversed in 1985 (as we will see, 1984 Lorenz dominates both 1983 and 1985), but between 1985 and 1986 the lowest eight deciles recovered some of their original share in total income. After 1986, there is a continuing deterioration of the distribution of income for three years, with 1989 recording the highest share for decile 10, and the lowest for deciles 2 to 7. There is some improvement in 1990 (which Lorenz dominates 1988 and 1989), but it is still much worse than earlier in the decade (1990 is Lorenz dominated by every single year between 1981 and 1987). In 1990, all but the richest 20% were worse off than in 1981, in relative terms.

This implies that gains by deciles 4 to 8 between 1981 and 1990, in terms of mean incomes as reported in Table 6, were due to economic growth - as implied by the survey data - rather than to redistribution. In relative terms, the top 20% of the distribution gained at the expense of the poorest 80%. In fact, despite growth in the overall mean, these inequality augmenting redistributions caused the poorest 30% to lose out even in absolute terms. This is in line with the findings of Datt and Ravallion (1992), who use a parametric method to decompose changes in poverty into a growth and a redistribution component. Comparing Brazil's performance in the 1980s with that of India, they state that:

> "With Brazil's worsening distribution (from the point of view of the poor), far higher growth rates than those of the 1980s would have been needed to achieve the same impact on poverty as India attained..." (p.294).

I now turn to the results of our investigation into stochastic dominance relations among the distributions in the decade. In keeping with common empirical practice, these are presented in terms of Pen parades, Lorenz curves, and Generalised Lorenz curves, rather than in terms of distribution or deficit functions. Section 2 contained a discussion of the equivalences between the two sets of concepts and definitions.

Pen parades plot incomes per percentile for each of the years in the sample. Graphs for 1981, 1983, 1986 and 1990 are shown in Figure 1. The usefulness of this tool for intertemporal comparisons of social welfare is that if the parade for year A lies nowhere below and at least at one point above the parade for year B then, as discussed in Section 2, social welfare is higher in A than in B for any social welfare function that is individualistic, additively separable and increasing in income (see the first theorem above).

Lorenz curves plot the cumulative share of income against the cumulative share of population, ranked in increasing order of income. Plots for 1981, 1986 and 1990 are shown in Figure 2. Lorenz dominance is diagrammatically analogous to Pen parade dominance, and indicates that inequality is lower in the dominant distribution for any inequality measure that satisfies the Pigou-Dalton Transfer Principle (see the third theorem in Section 2). Finally, a Generalised Lorenz curve plots the cumulative share of income scaled up by the distribution mean, against the cumulative share of population ranked in increasing order of income. Graphs for 1981, 1986 and 1990 are shown in Figure 3. Generalised Lorenz dominance is diagrammatically analogous to Lorenz dominance and indicates that social welfare is higher in the dominant distribution for any social welfare function that is individualistic, additively separable, increasing in income and strictly concave (see the second theorem in Section 2).

Since there are nine years of data, each of the three comparisons described above is possible for 36 pairwise combinations. For each of them, three outcomes are possible: A may dominate B, B may dominate A, or the curves may cross. Table 8 below summarizes all 108 possible dominance comparisons. Cell (i, j) has an L (G, P) if year i Lorenz (Generalised Lorenz, Pen parade) dominates year j. For example, if i = 1984 and j = 1983, we can see that the 1984 distribution Lorenz dominates that of 1983. A cell (i, j) may be empty of any of these three letters for two reasons: cell (j, i) may be full, or the relevant curves for i and j may cross.

The distributions are initially compared at the percentile level of aggregation, and the entries in Table 8 thus refer to sample dominance at that level. As Howes (1993a) has pointed out, this procedure is clearly statistical - in the sense that it is a comparison based on sample averages - and the inference of population dominance from the results should therefore be subject to a statistical test. Howes has proposed such a test, based on the simple test of sample mean differences. The key statistic is given by:

$$Z_i = \frac{\hat{\zeta}_i - \hat{\zeta}^*_i}{\left(\frac{\hat{C}_{ii}}{N} + \frac{\hat{C}^*_{ii}}{N^*}\right)^{\frac{1}{2}}} \qquad (12)$$

where $\zeta = (\zeta_i, ..., \zeta_w)$ is a vector of heights of curves (Lorenz, Generalized Lorenz or

Pen's Parades) at the disaggregated sample level; C_{ii} is the relevant element in the diagonal of the variance-covariance matrix associated with ζ; and N is the sample size. Z_i is asymptotically normally distributed. The individual null and alternative hypotheses are given by:

H_0: $\zeta_i \leq \zeta_i^*$,

H_1: $\zeta_i > \zeta_i^*$.

The complete test is described by Howes (1993) as an intersection-union test:

H_0: $\zeta_i \leq \zeta_i^*$, $\exists i$, i = 1,..., W.

H_1: $\zeta_i > \zeta_i^*$, $\forall i$, i = 1,..., W.

where the name refers to the fact that the rejection region of the test is the intersection of the rejection regions for all individual tests, and the non-rejection region is the union of all non-rejection regions. A rejection of the joint (or complete) null hypothesis allows one to infer population dominance from the sample dominance. Using Howes's endogenous bounds method, Table 8 denotes those percentile dominance results which were found to be statistically significant at the 5% level, for a range of 99% (*) or 100% (**) of the distribution, based on checking the complete disaggregated sample.

Inspection of the table reveals that most dominance results obtained from a comparison at the percentile level of aggregation are found to be statistically significant based on a comparison at the fully disaggregated sample level. This allows us to interpret the results as referring to the Brazilian population in the discussion below.

The two most remarkable general features of the table are, first, that there are very few G or P dominance results, but many cases of Lorenz dominance and, second, that the latter are heavily concentrated above the diagonal. The interpretation of the second observation is that there was a marked trend for increasing inequality in the decade. For example, 1988, 1989 and 1990 are all Lorenz dominated by every single year between 1981 and 1987. The interpretation of the first observation is that clear-cut welfare dominance results are much harder to find, since growth in mean reported income in the decade was offset by the increase in inequality, preventing social welfare from rising unambiguously for the aforementioned wide classes of social welfare functions.

Table 8: Inequality and Welfare Dominance Results

	1981	1983	1984	1985	1986	1987	1988	1989	1990
1981		G**,P*	G**,P*	L**	L	L**	L**	L**	L**
1983				L		L	L*	L**	L*
1984		L		L	L	L**	L**	L**	L**
1985							L**	L**	L**
1986	G**, P**	G**, P**	G**, P**	G**, P**		L,G**, P**	L*,G** P**	L**, G**	L,G** P**
1987							L*,G*P	L**	L, G**
1988									
1989							G**, P**		G**, P*
1990							L	L**	

In what follows, we briefly discuss some of the more specific results available from Table 8, and indeed some comparisons where crossings occurred. We turn first to the Pen parades. The striking feature of the curves is the difference between mean incomes among the rich and mean incomes among the poor in each year. We have already seen in Table 6 that mean incomes among the top ten percent are around 50 to 60 times higher than among the poorest ten percent, but when we examine the top one percent the differences are even more marked. Average income of the top one percent in 1981 was $1693, compared with the average of the poorest one percent of just $5. Average income of the top one percent in 1990 was $2236, compared with $4 for the poorest one percent. In each year the distribution is so skewed in favour of the rich, that only the top 25% of the population have incomes above the overall average.

According to the Pen parades, welfare in 1990 is higher than in 1981 for the top 67%, but lower for the poorest 26%[18]. This reflects again the fact that growth in the 1980s - even

[18] The parades for 1981 and 1990 cross three times between the 26% and 33% points.

if it was as high as the survey data would suggest - did not benefit the poorest households in Brazil. But its absence does seem to hurt everyone: 1981 dominates both 1983 and 1984, reflecting the serious society-wide effects of the recession. This is in line with the large increases in poverty during the recession described by Datt and Ravallion (1992), and confirmed by our findings in the next section. The most impressive year, of course, is 1986, where growth and the inflation-reducing Cruzado Plan combined to produce very large welfare gains.

The Lorenz curves confirm the picture of rising inequality over the period, with dominance of the 1981 curve over all those from 1985 onwards. 1983 also dominates 1985, 1987, 1988, 1989 and 1990. 1984 dominates all subsequent years and 1985 dominates 1988, 1989 and 1990. Inequality was therefore unambiguously lower at the beginning of the decade than at any subsequent time. The Lorenz curve for 1990 lies below all those for 1981 - 1987, but above those for 1988 and 1989. Between 1985 and 1986 there is a fall in inequality, with dominance up until the top percentile, which confirms the picture described by the summary inequality measures earlier - the bottom-sensitive Gini and Theil index both fall between 1985 and 1986, whereas the top-sensitive CV rises. The Lorenz curve for 1986 dominates that of 1987, hence inequality unambiguously rises[19].

In terms of Generalised Lorenz dominance, as for Pen parade dominance, the most remarkable feature is that 1986 G-dominates every other year in the sample. Since mean income in 1986 is higher than in any other year in the decade, it clearly could not be dominated by them. But in fact, the mean is so high that 1986 not only G-dominates 1987, 1988, 1989 and 1990 (years in which mean incomes were lower and inequality was higher), it also dominates 1981 and 1984, when inequality was unambiguously lower, and 1983 and 1985, whose Lorenz curves its crossed.

In summary, inequality increased unambiguously during the 1980s, causing welfare

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[19] We would, however, expect a crossing of the 1986 and 1987 Lorenz curves near the top of the distribution, because of the behaviour of the summary measures (both the Gini and Theil rise, while the CV falls). Although inspection of the percentile points does not reveal a crossing, a finer partition does. This is why this dominance result is not statistically significant.

amongst the poorest third of the population to decline, despite growth in the (reported) overall mean income. The bottom of the distribution experienced a substantial, but temporary, improvement in 1986. I now turn to an examination of poverty in the decade, using the PNAD data set.

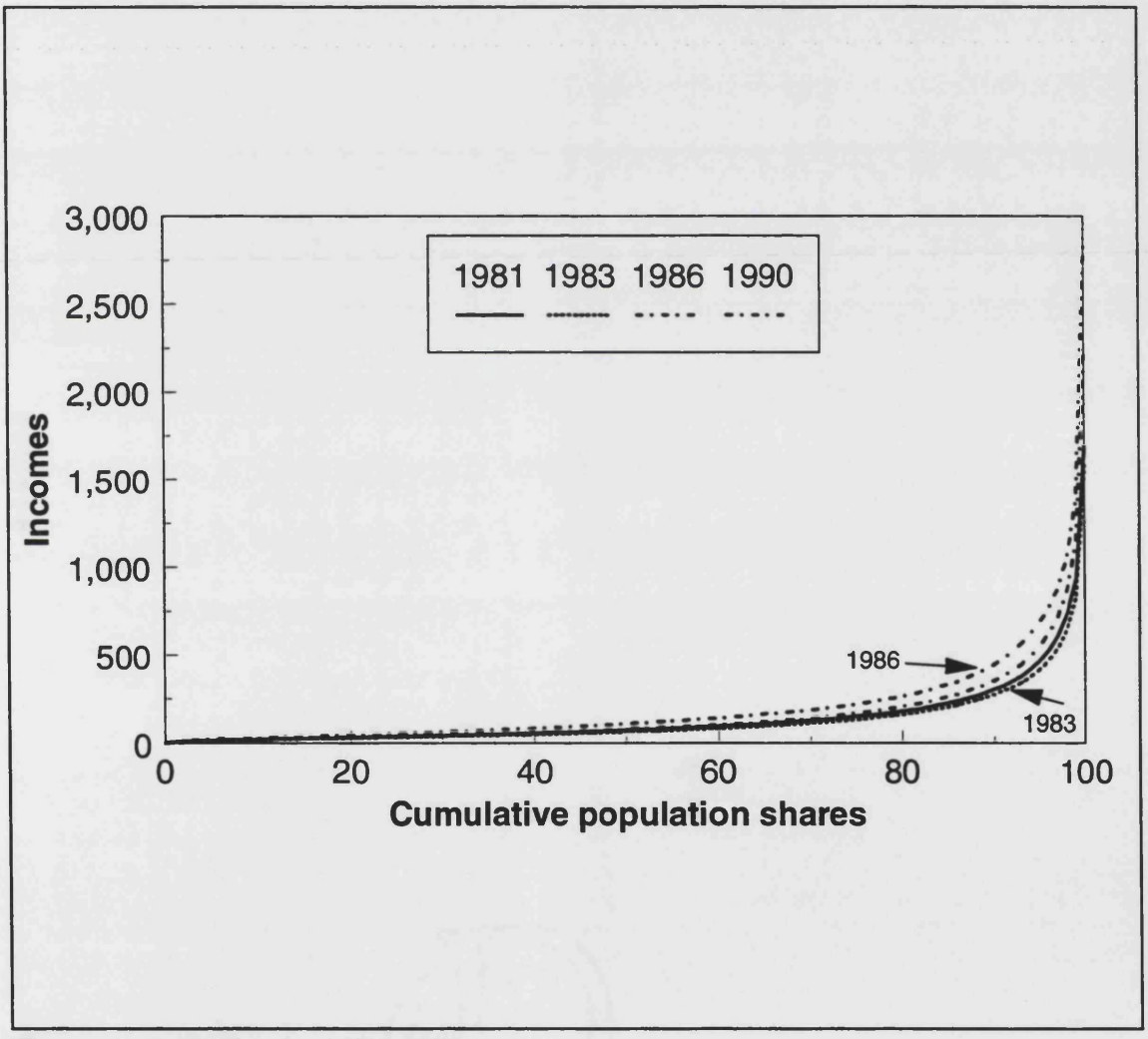

Figure 1. Pen's Parade: 1981-1990

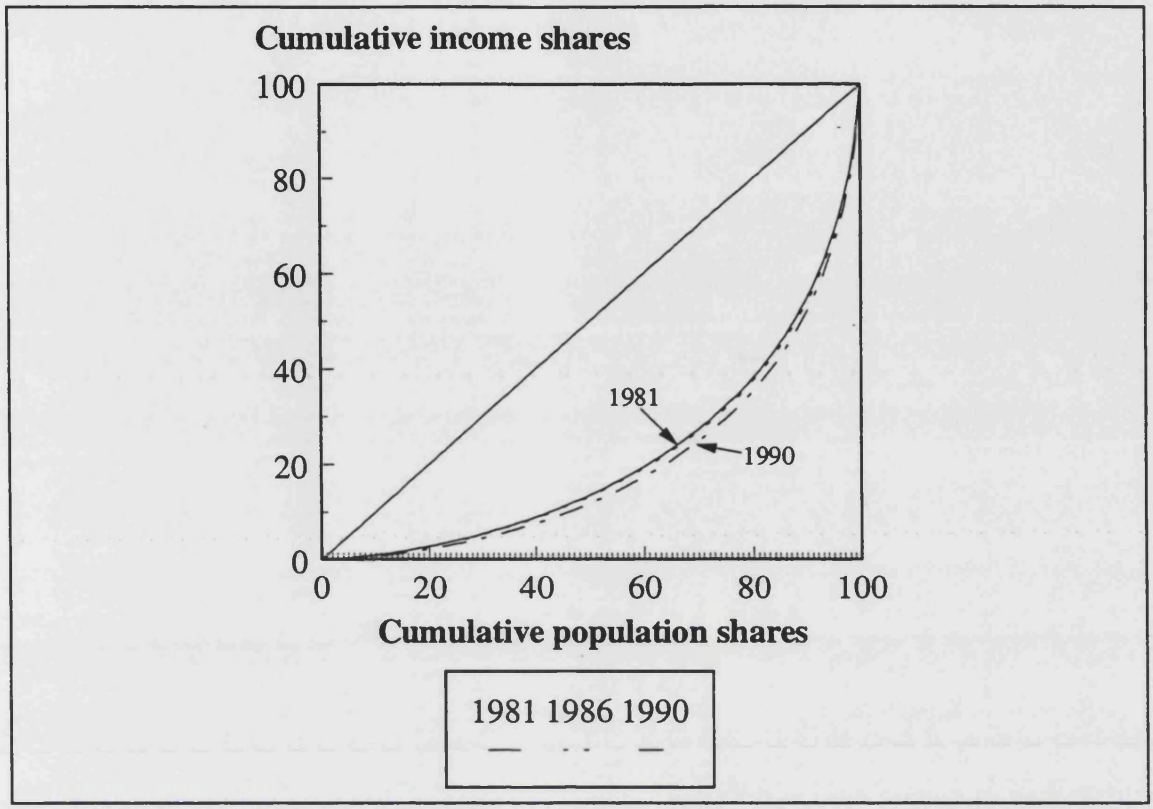

Figure 2. Lorenz Curves: 1981-1990

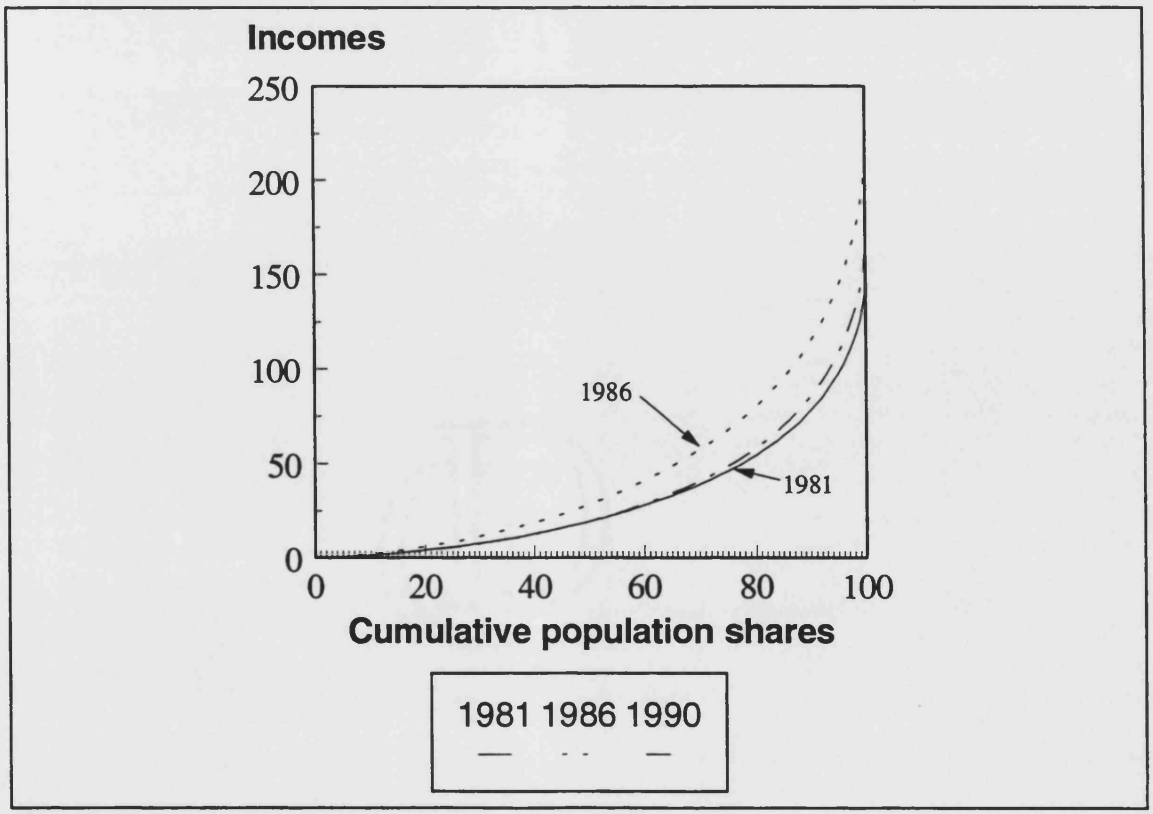

Figure 3. Generalised Lorenz Curves: 1981-1990

5) Poverty in the 1980s.

Given the results of the previous section - particularly the absolute fall in mean incomes for the bottom three deciles - it is not surprising that poverty as a whole increased over the 1980s. Although this chapter has been principally concerned with inequality, this section explores the poverty trends in greater detail. Following Sen (1981), the discussion is structured according to the two component aspects of poverty analysis: the identification problem and the aggregation problem. The first subsection discusses the choice of poverty line(s), which identifies the poor within the population. Some of the merits and limitations of the adopted approach are described.

The second subsection presents aggregated information on changes in the extent of poverty in Brazil, according to three different aggregation procedures - one for each of the poverty measures computed: the headcount index (H), the normalized poverty deficit (NPD) and the Foster-Greer-Thorbecke (FGT) index with the poverty aversion parameter $\alpha=2$. In addition, just as scalar measures were complemented by an investigation of stochastic dominance in the analysis of inequality, this subsection discusses poverty mixed dominance among the years studied.

5.1) Identifying the Poor: The Choice of Poverty Line.

Although the debate on the measurement of poverty has included views that poverty should be seen as simply an aspect of inequality - referring, for example, to "the nature and size of the differences between the bottom 20 or 10 per cent and the rest of society" (Miller and Roby, 1970, p.143) - most researchers see poverty as a concept inherently distinct from inequality. The distinguishing feature is closely related to the focus axiom of poverty analysis: for a given poverty line, measures of poverty satisfying this axiom do not change if there is no change in the incomes of the poor, regardless of what happens among the non-poor. This is to say: once the set of the poor has been identified, poverty is an exclusive attribute of the poor, not of their position relative to the non-poor.

It follows immediately that the choice of a poverty line - which separates the poor from the non-poor - is crucial; any poverty measure can only be understood with reference to a particular poverty line. This section describes the derivation of the poverty line adopted

in this chapter. The first choice facing any empirical researcher in this area is whether to embrace an absolute or relative concept of poverty. I follow Sen (1983), who argues for an "irreducible absolutist core in the idea of poverty"(p.159), and adopt a poverty line based on an estimate of the income needed to meet basic needs, rather than simply a fraction of median income.

In particular, I use a set of regionally specific poverty lines which was painstakingly calculated by Rocha (1993), intended precisely for use with PNAD 1990 data. Rocha starts her procedure by following standard practice and computing the minimum cost of food baskets required to attain the FAO recommended caloric requirements. Because of substantial differences across the country's regions - and within these regions, from metropolitan to other urban areas and then to rural areas - in both consumption patterns and prices, a food basket was calculated for each area specifically.[20] The food costs for each area therefore respect not only price differences, but also differences in tastes and local food availability across the different areas.

Once these food baskets had been costed, Rocha decided to deviate from the standard procedure of multiplying this number by the inverse of an Engel coefficient to obtain the poverty line. She argues convincingly that substantial relative price changes in Brazil during the decade meant that the Engel coefficient was not stable, and that - given the availability of detailed expenditure data from POF - it was preferable to calculate non-food expenditure amongst the poor directly.[21] This she did for each separate metropolitan area again, and adding the non-food expenditure amongst the poor to the food basket cost

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[20] In fact, this was done for the nine metropolitan areas (Belém, Fortaleza, Recife, Salvador, Belo Horizonte, Rio de Janeiro, São Paulo, Curitiba and Porto Alegre), as well as Brasilia and Goiânia, for which a recent (1987) expenditure survey data set was available. This was the Pesquisa de Orçamentos Familiares (POF). For the other urban and rural areas, conversion factors were borrowed from an earlier work by Fava (1984), which were based on the most recent available data for these areas, the 1975 Estudo Nacional da Despesa Familiar (ENDEF).

[21] 'The poor' amongst whom she computes non food expenditures are those who, according to information recorded by POF, were unable to meet *minimum* caloric requirements as specified by FAO. It is interesting to note that if the criterion had been *recommended* caloric requirements, which were used to derive the food basket component of the poverty lines, some areas would have had over half of the population counted as 'poor' for the purpose of studying non-food expenditure.

gives her regional poverty lines. These were updated for 1990 from the 1987 current prices by use of the INPC price index. This makes it particularly compatible with our data set, where conversion to real values also used the INPC to derive constant 1990 cruzeiros (and then dollars). The values of the regionally specific poverty lines, in 1990 US dollars, for the relevant PNAD regions are reported in Table 9 below, which is converted from table XIII in Rocha (1993). For greater detail on the construction of these lines, such as the specific food baskets in each metropolitan area, the exact non-food expenditures by category, or the conversion factors from metropolitan lines to other urban and rural areas, please see Rocha (1993).

Before presenting the aggregation results, it should be noted that there is one potentially serious problem with the Rocha methodology. By using regionally specific food and non-food bundles, as well as prices, to cost basic needs, it is possible that the resulting poverty lines are not equivalent to a constant level of utility or well-being across the regions. If, for instance, the price of food relative to non-food is higher in urban than in rural areas, triggering a substitution effect, it could be the case that utility amongst urban households consuming a bundle that includes the recommended FAO caloric intake is higher than amongst rural households consuming a (different) bundle that yields the same calories.

This situation is illustrated in Figure 4 below. Let us abstract for the moment from the different compositions of consumption expenditures within the food and the non-food bundles, and thus from relative prices within them, and consider a schematic example with only two commodities (food F and non-food N) and two regions (urban U and rural R). Let D be the quantity of food that yields the FAO recommended caloric intake. Let the slope of R denote the relative prices P_F/P_N in the rural region, and U in the urban region. The diagram illustrates that consumers with identical (homothetic) preferences will reach consumption of D at different levels of utility, with the urban households having a higher real income.

But given Rocha's method, the poverty lines would be given by:

$$\text{Rural poverty line} = P_F\,(OD) + P_N\,(OB)$$

$$\text{Urban Poverty line} = P_F\,(OD) + P_N\,(OA).$$

These would classify urban households with utility levels below U_C as poor, whereas rural households would only be counted as poor when their utility levels were lower than U_E.

For those who take a utilitarian view of poverty, rather than one based lexicographically on food consumption, this is a shortcoming of this identification methodology.

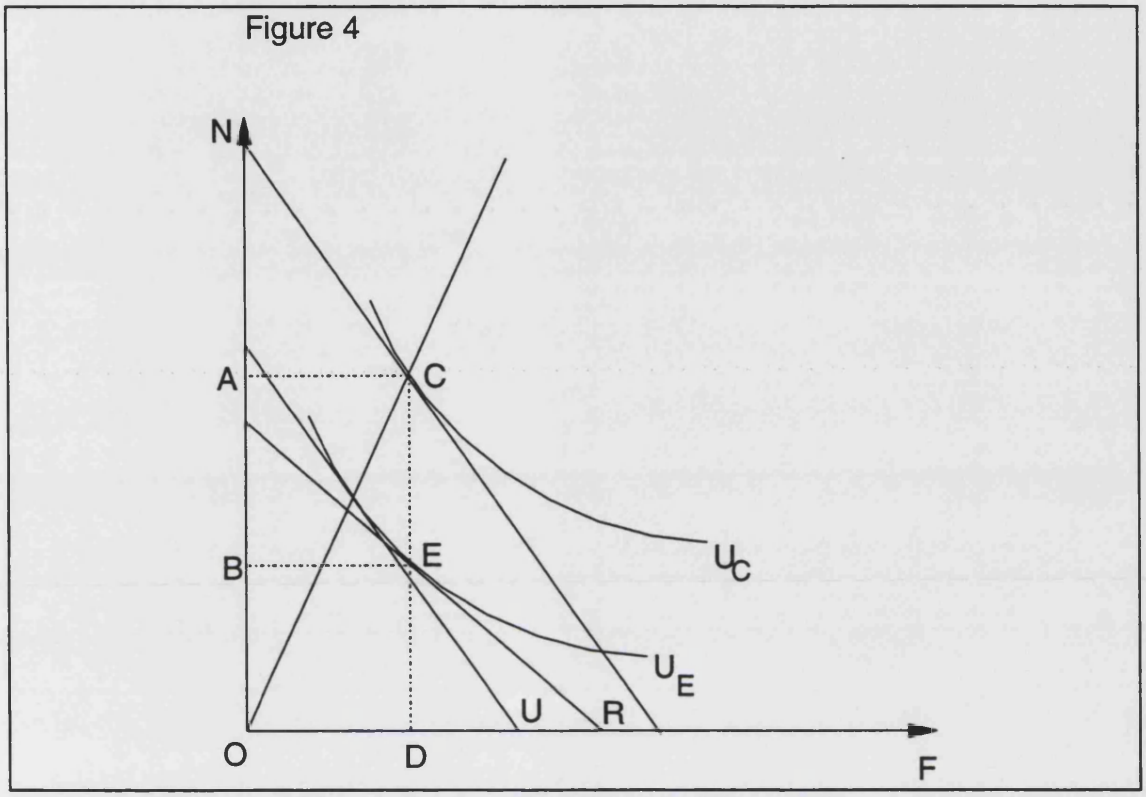

Figure 4: Different utility levels for urban and rural households consuming the same amount of food.

This problem is common to a number of other approaches, such as the Food Energy Intake (FEI) method used, inter alia, by Indonesia's Central Bureau of Statistics, as noted by Ravallion and Bidani (1994). They suggest an alternative method, which is essentially a variant of the cost of basic needs (CBN) approach, where prices are allowed to vary regionally, but the composition of the food bundle is fixed as the (appropriately scaled up) average consumption level of each commodity in some reference group (e.g. those who fail to reach the FAO recommended caloric intake). See Ravallion and Bidani (1994) for further details.

Despite this difficulty, Rocha's poverty lines are still the best available for the analysis below. There are three reasons for this. First, re-estimating a poverty line for each region using the Ravallion and Bidani method would have required access to the detailed ENDEF and POF data sets, which I did not have. Amongst the available absolute poverty

Table 9: Poverty lines for the PNAD regions.

PNAD's regions	Value (US$ 1990)
Region 1	
Metropolis of Rio de Janeiro	110.26
Urban	68.36
Rural	49.62
Region 2	
Metropolis of São Paulo	117.49
Urban	74.02
Rural	47.00
Region 3	
Metropolis of Curitiba	94.44
Metropolis of Porto Alegre	65.56
Urban	60.00
Rural	40.00
Region 4	
Metropolis of Belo Horizonte	90.61
Urban	60.71
Rural	35.34
Region 5	
Metropolis of Fortaleza	68.89
Metropolis of Recife	91.71
Metropolis of Salvador	105.29
Urban	62.04
Rural	37.23
Region 6	
Brasília	112.72
Region 7[1]	
Metropolis of Belém	63.88
Urban	56.85
Region 8[2]	
Goiânia	107.12
Urban	81.41
Rural	41.84

Notes: [1]No data was collected for the rural population of the North.
[2]The rural poverty line in region 8 is the unweighed average of all other rural poverty lines.

Source: Rocha, 1993.

identification approaches, the Rocha lines are preferable to its competitors, such as the minimum wage, whose real value has varied widely over time.

Second, the Ravallion and Bidani approach is itself vulnerable to criticism, albeit for different reasons. One trade-off with the Rocha method is that by fixing the consumption bundle used to calculate the poverty threshold (which does eliminate the substitution effect problem of relative price variations), their approach ignores differences in regional availability. The 'average bundle' amongst all consumers will inevitably bias weights towards foodstuffs consumed in the more populous areas, so that the final poverty line in Brazil would weigh the prices of rice and açaí (a tropical fruit) identically across the country, and most probably very differently from the shares of those two commodities in the diet of a family in rural Acre. While Ravallion and Bidani have highlighted an important issue in poverty identification, it is not clear a priori that the gains from eliminating the substitution effect necessarily outweigh the losses from regional specificity in food availability.

Third, as with the difficulties associated with income reporting discussed in Section 3, it is likely that the problems with Rocha's poverty lines are less severe if one uses them principally to establish trends, i.e. if one pays less attention to the absolute values of the poverty measures described below than to how they changed during the decade.

5.2) Aggregation: poverty measures and mixed dominance: 1981-1990.

Three measures were chosen to describe poverty in each year, and changes in poverty during the decade: the headcount index, the normalised poverty deficit and the Foster-Greer-Thorbecke index (with $\alpha=2$). These indices and their properties are widely known, dispensing further discussion here. They can all be expressed as members of the parametric FGT class, the formula for which is given in Appendix B. The values are shown in Table 10, and together they take into account the three *I*s of poverty - incidence, intensity and inequality amongst the poor. Not surprisingly, the poverty picture reflects the behaviour of the mean incomes for the bottom deciles, reported in Table 6. Between 1981 and 1990, we observe a rise in poverty according to all measures. The rise in the headcount index indicates that there were marginally more poor people by the end of the decade than there had been in the beginning. In addition, the fact that the normalized

poverty deficit grew by proportionately more than the headcount index (6% versus 1%) is evidence that the poor were, on average, further away from the poverty line.[22] Finally, the 10% rise in FGT(2) suggests that incomes among the poor were also distributed more unequally.

Table 10: Brazil 1981-1990. Poverty measures.

	1981	1983	1984	1985	1986	1987	1988	1989	1990
Headcount	0.445	0.553	0.520	0.457	0.296	0.417	0.439	0.403	0.450
NPD	0.187	0.235	0.232	0.195	0.109	0.178	0.194	0.177	0.199
FGT2	0.104	0.135	0.132	0.109	0.056	0.099	0.112	0.101	0.114

Nevertheless, as in the case of the inequality measures, this increase was not monotonic. In fact, poverty appears to have behaved more (anti-)cyclically than inequality, with sharp increases during recessionary periods and substantial declines when growth resumed.[23] All three measures indicate a sharp increase in poverty from 1981 to 1983, due to the recession. Indeed, all of the measures have 1983 as their peak year for the decade. All measures then decline monotonically until 1986, although until 1985 each was still above its 1981 level. The really sharp reduction in poverty came in 1986, as was to be expected from the previous welfare dominance results for that year. The underlying story seems to reflect the positive impact of growth in 1984-86 on poverty reduction, but the magnitude of the shift in 1986 is compatible with the hypothesis that the abrupt lowering in inflation brought about by the Cruzado Plan had an additional impact.

All three measures are at their minimum in 1986 and then rise until 1990, except for a temporary decline in 1989. Overall, the sharp increases in poverty during the early

[22] Using the poverty measure definitions contained in Appendix B, it is immediate that the average normalized distance between individual incomes of the poor and the poverty line equals the ratio NPD / H.

[23] I return to this proposition in Chapter 8, where relations with macroeconomic variables are investigated explicitly.

recession years, reinforced by the increases in the post-1986 inflationary period, more than offset the gains made in 1984-86. Poverty is shown to have increased according to all three measures from 1981 to 1990, which is fully compatible with the losses in mean decile income for the first three deciles reported in Section 3.

Nevertheless, while inequality rose persistently and unambiguously during the 1980s, as revealed by the Lorenz dominance results of Table 8, the picture is less clear for poverty. This is brought out by Table 11 below, which is analogous to Table 8, but where D in cell (i, j) indicates that year i displays poverty mixed dominance over year j. Let z denote the value of a poverty line. Formally a distribution F displays poverty mixed dominance over distribution F* (FD_mF^*) iff $G(y_k) \leq G^*(y_k)$, $\forall y_k \leq z^-$, and $F(y) \leq F(y^*)$, $\forall y \in (z^-, z^+)$, and either $G(y_k) < G^*(y_k)$, $\exists y_k \leq z^-$, or $F(y) < F(y^*)$, $\exists y \in (z^-, z^+)$. In this definition, $G(y_k)$ is the deficit curve derived from distribution F(y), as defined by equation (5); z^- is the lower bound on the set of poverty lines one might wish to consider, and z^+ is the upper bound on that set. Naturally, if one wishes to consider dominance with respect to a single poverty line, then $z^- = z^+$, but allowing for a range of poverty lines tests the sensitivity of poverty comparisons to variations in the poverty line itself.

In deriving the dominance comparisons presented below, z^- was set equal to the lowest of the set of Rocha's lines, presented in Table 9 above (US$ 35.34), and z^+ as the highest (US$ 117.49), as these appeared to be natural bounds for a nationwide poverty study. Whereas in deriving the scalar measures reported in Table 10, regional household income per capita vectors were compared with their specific poverty line; in the dominance analysis, the national distribution is analyzed as a whole, with the set of pertinent poverty lines ranging from z^- to z^+. The interval between the two is a large one, so that poverty mixed dominance in our analysis involves a stringent requirement of first order dominance over a large percentile range of the distributions. From the definition above, and the discussion in Section 2, it is clear that mixed dominance consists essentially of second order dominance from zero to the lowest poverty line, and first order dominance between the lowest and the highest poverty lines. The concept was developed by Howes (1993a), as an extension of the application of second order dominance to poverty analysis by Atkinson (1987).

Howes (1993b) argues that while:

> "Poverty first-order stochastic dominance can legitimately be viewed as too demanding a criterion..., poverty second-order stochastic dominance may... be regarded as too lenient a criterion, since it covers only functions which satisfy the transfer principle everywhere." (p.12).

First order dominance covers a very wide class of opulence functions[24], requiring only that they be increasing in income and respect the focus axiom, but it is a very stringent requirement, seldom met in practice. Second order dominance, used in Atkinson's (1987) paper which launched dominance analysis of poverty, is less demanding, but has one shortcoming. The class of functions it covers is much smaller, and it requires that welfare or opulence functions satisfy the transfer axiom throughout the distribution. This excludes the commonest of all poverty measures, (or rather, its negative, the opulence function corresponding to) the headcount index.

Howes (1993b) demonstrates that mixed dominance covers an intermediate class of functions, requiring that they be increasing with income, that they satisfy the focus axiom and the transfer axiom, except for situations in which crossings of the poverty line arise. Poverty mixed dominance would then imply that all poverty measures (opulence functions) in this class rank poverty in the two distributions in the same way. Poverty mixed dominance of year i (e.g.1981) over year j (e.g. 1983) signifies that poverty is higher in j than in i for all measures in the class, and for all poverty lines in (z^-, z^+). This class now includes all poverty measures in the Foster-Greer-Thorbecke parametric family, including the headcount (see Appendix B to Chapter 7).[25]

Before presenting the results, a word is required on the use of Pen parades and Generalized Lorenz curves instead of distribution functions and deficit curves for checking poverty mixed dominance. As mentioned in Section 2, it has been shown that while second order dominance and (Generalized) Lorenz dominance are not perfect substitutes in general, the relationship $FD_2F^*(y)$ iff $FD_LF^*(p)$ does hold if $p = F(y) \leq F^*(y)$. This

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[24] 'Opulence functions', in Howes's terminology, are negatives of poverty measures.

[25] Mixed stochastic dominance of year i over year j, with the set of poverty lines given by (z^-, z^+), implies second (but not first) order stochastic dominance of i over j until z^+. First order stochastic dominance of i over j until z^+ implies mixed (and second order) stochastic dominance. See the definitions in Section 2, and the discussion in Howes (1993a).

allowed me to use them interchangeably for comparing complete (uncensored) distributions, since in that case p = 1 = F(y) = F*(y). Howes (1993b) shows that they can also be used interchangeably for poverty mixed dominance, since satisfying first order dominance over (z^-, z^+) necessarily satisfies the required condition. The results below have thus been obtained by comparing Generalized Lorenz curves up to $p = F(z^-)$, and Pen parades between p and $p^+ := \max (F(z^+), F^*(z^+))$.

Table 11: Poverty Mixed Dominance Results

	1981	1983	1984	1985	1986	1987	1988	1989	1990
1981		D	D						
1983									
1984									
1985									
1986	D	D	D	D		D	D	D	D
1987							D		D
1988									
1989							D		D
1990									

This Table confirms the thrust of the results inferred from the scalar measures. Its first striking feature is the dominance of 1986 over every other year in the sample, indicating that poverty was unambiguously lower in that year, for any choice of poverty line between US$ 35.34 and US$ 117.49 monthly gross income per capita. This is of course consistent with the much lower values for all three reported measures in that year, as well as with the welfare dominance results of Table 8. In fact, since 1986 displayed both G and P dominance over every other year, except 1989, the result above had to follow for those years. It does add new information to a poverty comparison with 1989, over which 1986 displayed second but not first order welfare dominance. The mixed dominance result reported above indicates that the P crossing between the two years did not occur over the interval (z^-, z^+). The overall picture clearly confirms that the rapid growth in the years

leading to and including 1986, combined to the dramatic reduction in the inflation tax burden, had a substantial poverty reducing effect.

Another way to look at the Table is to look for the years most often dominated, i.e those with most entries in their columns. These are years when poverty was most often unambiguously greater than at other times. The worst periods were the end of the decade (again except for 1989) and the 1983 recession, with a lagged effect lasting into 1984. Despite the stringent requirements embodied in the mixed dominance comparisons, both 1988 and 1990 were dominated by 1986, 1987 and 1989. 1983 and 1984 were dominated by 1981 and 1986.

The natural conclusion is that poverty behaved anticyclically, as one might expect: it rose in the recession of 1983, fell following the resumption of growth in the mid-80s, and reached a pronounced minimum in 1986. Then it rose again, with 1988 and 1990 being the most often dominated years in the period. While all three measures in Table 10 suggest that poverty was higher in 1981 than in 1990, the fact that there was no dominance of the latter over the former suggests, as mentioned earlier, that the poverty increase over the decade was less clear and unambiguous than the increase in inequality.

6) Robustness of the Analysis with Respect to the Choice of Equivalence Scales.

As noted in Section 3, the analysis so far has been based on per capita household incomes, with each individual as the income recipient. This has been common practice in works on Brazilian income distribution, and the same income variable is used by Barros, Mendonça and Rocha (1993), Datt and Ravallion (1992) and Rocha (1993), to mention but a few. Nevertheless, if the objective is a comparison of interpersonal levels of welfare, this approach clearly represents a strong assumption on intra-household scale economies, namely that they do not exist.

This is at odds with best practice in distributional analysis for many other countries, and a substantial literature has evolved on means to take into account differences in needs and characteristics across households, when comparing the welfare levels of individuals in them. This is most commonly done through the adoption of an equivalence scale. It is not my intention to survey this literature here, as this was done by Coulter, Cowell and

Jenkins (1992b).

In that survey, the authors review that 'personal well-being' - or equivalised income - Y can be seen conceptually as a function $Y_i = f(X_i, \mathbf{p}_i, \mathbf{a}_i)$, where X denotes household money income, **p** is the relevant price vector, and **a** is a vector of household characteristics. Households are indexed i = 1,..., H. Equivalence scales, usually denoted M_i, help map money incomes X into equivalised incomes Y, as follows: $Y_i = X_i/M_i$, for each i = 1,..., H, where M_i is given as follows:

$$M_i = \frac{C(u, \underline{p}, \underline{a}_i)}{C(u, \underline{p}, \underline{a}_r)} \qquad (13)$$

Equation (12) is the ratio of two 'cost functions', where u is some common level of well-being or utility, the prices faced by different household types is assumed constant, and the household characteristics vary. The subscript r is for a reference household type.

Historically, there have been a number of different approaches to estimate M_i, as discussed by Coulter, Cowell and Jenkins (1992b). These have included econometric estimation of cost functions, based on demand functions (e.g. the Engel and the Rothbarth methods); subjective scales based on responses to questionnaires about how people regard their (monetary) income levels, given their family characteristics (e.g the Leyden approach); budget scales based on the judgements of experts as to what consumption bundles are necessary for different family compositions (particularly used in connection with attaining a given nutritional level); and so on.

Much as in the case of scalar inequality measures discussed in Section 2, the wide variety of equivalence scales that have been suggested may seem bewildering. Fortunately, it has been suggested that a simple parametric class of equivalence scales, due to Buhmann et al (1988) can, by appropriate choice of the parameter θ, proxy for most of the more complex scales. The Buhmann et al scale is given by $M_i = s_i^{\theta}$, where s_i is the size of household i. This chapter follows Coulter, Cowell and Jenkins (1992a, b) in using this scale to achieve a tractable discussion of the sensitivity of the poverty and inequality measures presented above to changes in equivalence scale. Like them, I am not suggesting that household size is the only conceptually important family attribute to help determine

differences in needs. I simply take advantage of the fact that varying the parameter θ allows a researcher to investigate the behaviour of scalar measures under very different assumptions about household scale economies.

Following Coulter et al (1992a), the empirical results below take the form of values for a number of scalar poverty and inequality measures for five different values of θ (= 0.00; 0.25; 0.50; 0.75; 1.00). Results are presented for the three inequality measures discussed above, namely the Gini coefficient, the Theil Index (G(1)), and the coefficient of variation, as well as for G(0), which is used extensively in the decompositions of Chapter 8. The poverty measures are the Headcount index, the normalized poverty deficit and the Foster-Greer-Thorbecke ($\alpha = 2$), as in Section 5. For reasons which will become apparent below, we investigate the variation of these poverty measures with θ for two different poverty lines: the absolute, regionally-specific Rocha lines listed in Table 9, and a relative poverty line equal to 84% of median income.[26] The exercise was also performed for a relative line defined in terms of the mean, but the results are essentially the same as for the median, and are not reported below.[27] The variation of these measures with the parameter θ are presented in Table 12 and Figures 5 and 6 below.

The Table and figures reveal that, for Brazil as for the United Kingdom, scalar measures of inequality and poverty are reasonably sensitive to the choice of equivalence scale. Four points deserve special mention. First, Figure 5 reveals that the trend of increasing inequality during the 1980s, which I have emphasized throughout this chapter, is robust to the choice of equivalence scale and, furthermore, that this robustness does not depend on the choice of particular scalar measure. For all four measures investigated, inequality was higher in 1990 than in 1985 and in 1985 than in 1981, for all values of theta. This suggests that the Lorenz dominance of 1981 over both 1985 and 1990, and that of 1985

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[26] In choosing a relative poverty line, the choice of proportion of the median is often arbitrary. In this instance, faithful to the absolutist core of poverty discussed in Section 5.1, a value (of 84%) was chosen to give the income earned by the percentile equal to the 1981 headcount, i.e the implied 'national average' poverty line.

The discrepancy between the two headcount values for 1981 is due to approximation in the choice of income level.

[27] The choice of presenting the line relative to median income, rather than to the mean, is due to its greater robustness (see Cowell and Victoria-Feser, forthcoming). The results for the line defined w.r.t. the mean are available from the author on request.

over 1990 are also robust to the choice of equivalence scale. In this respect, it seems that the choice of per capita income ($\theta = 1$) as unit of analysis, in this and most other works on Brazil, does not affect conclusions regarding inequality trends over time.

Second, the analysis shows that for Brazil in the 1980s, all four inequality measures rose monotonically with theta. This suggests that if one is concerned with levels rather trends of inequality, the choice of per capita income implies a choice for the upper bound of inequality values. In this respect, the choice of per capita income, assuming away all economies of scale within the household, seems to exaggerate the level of inequality. Since most researchers would probably agree that the marginal cost of an extra person in the household does decline, however moderately, within a normal range, future analysis of inequality levels in Brazil should perhaps take a less cavalier attitude to equivalence scales. The problem at least deserves addressing.

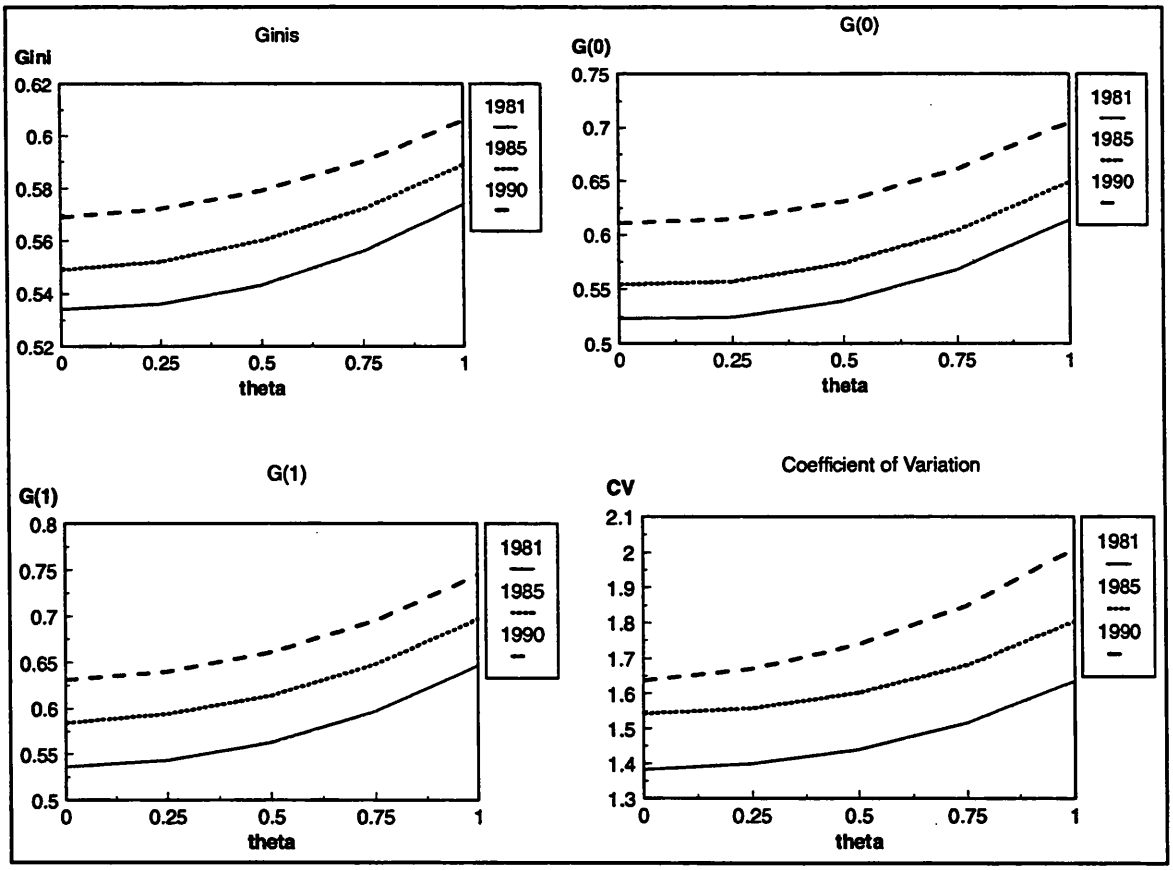

Figure 5: Inequality Measures and the Equivalence Scale: 1981, 1985 and 1990.

Table 12: Sensitivity of Inequality and Poverty Measures to Choice of Equivalence Scale.

Theta	0.00	0.25	0.50	0.75	1.00
1981					
Gini	0.534	0.536	0.543	0.556	0.574
G(0)	0.523	0.524	0.539	0.568	0.614
G(1)	0.536	0.543	0.563	0.597	0.647
CV	1.383	1.399	1.441	1.517	1.635
Fixed Poverty Line					
Headcount	0.018	0.047	0.122	0.258	0.445
NPD	0.006	0.014	0.037	0.092	0.187
FGT(α = 2)	0.003	0.006	0.017	0.049	0.104
Relative Poverty Line (84% of median)					
Headcount	0.430	0.430	0.430	0.431	0.437
NPD	0.191	0.188	0.188	0.191	0.197
FGT(α = 2)	0.110	0.107	0.107	0.110	0.116
1985					
Gini	0.549	0.552	0.560	0.572	0.589
G(0)	0.554	0.557	0.574	0.604	0.649
G(1)	0.584	0.594	0.614	0.648	0.697
CV	1.542	1.558	1.602	1.680	1.804
Fixed Poverty Line					
Headcount	0.027	0.060	0.138	0.280	0.457
NPD	0.008	0.018	0.041	0.100	0.195
FGT(α = 2)	0.004	0.008	0.020	0.050	0.109
Relative Poverty Line (84% of median)					
Headcount	0.433	0.431	0.431	0.433	0.435
NPD	0.193	0.189	0.189	0.193	0.197
FGT(α = 2)	0.111	0.108	0.108	0.111	0.116

1990					
Gini	0.569	0.572	0.579	0.590	0.606
G(0)	0.611	0.615	0.631	0.661	0.705
G(1)	0.631	0.640	0.661	0.695	0.745
CV	1.637	1.670	1.739	1.849	2.009
Fixed Poverty Line					
Headcount	0.036	0.078	0.159	0.287	0.450
NPD	0.011	0.024	0.053	0.110	0.199
FGT($\alpha = 2$)	0.005	0.011	0.026	0.057	0.114
Relative Poverty Line (84% of median)					
Headcount	0.432	0.439	0.439	0.440	0.446
NPD	0.206	0.205	0.205	0.209	0.214
FGT($\alpha = 2$)	0.125	0.123	0.123	0.127	0.132

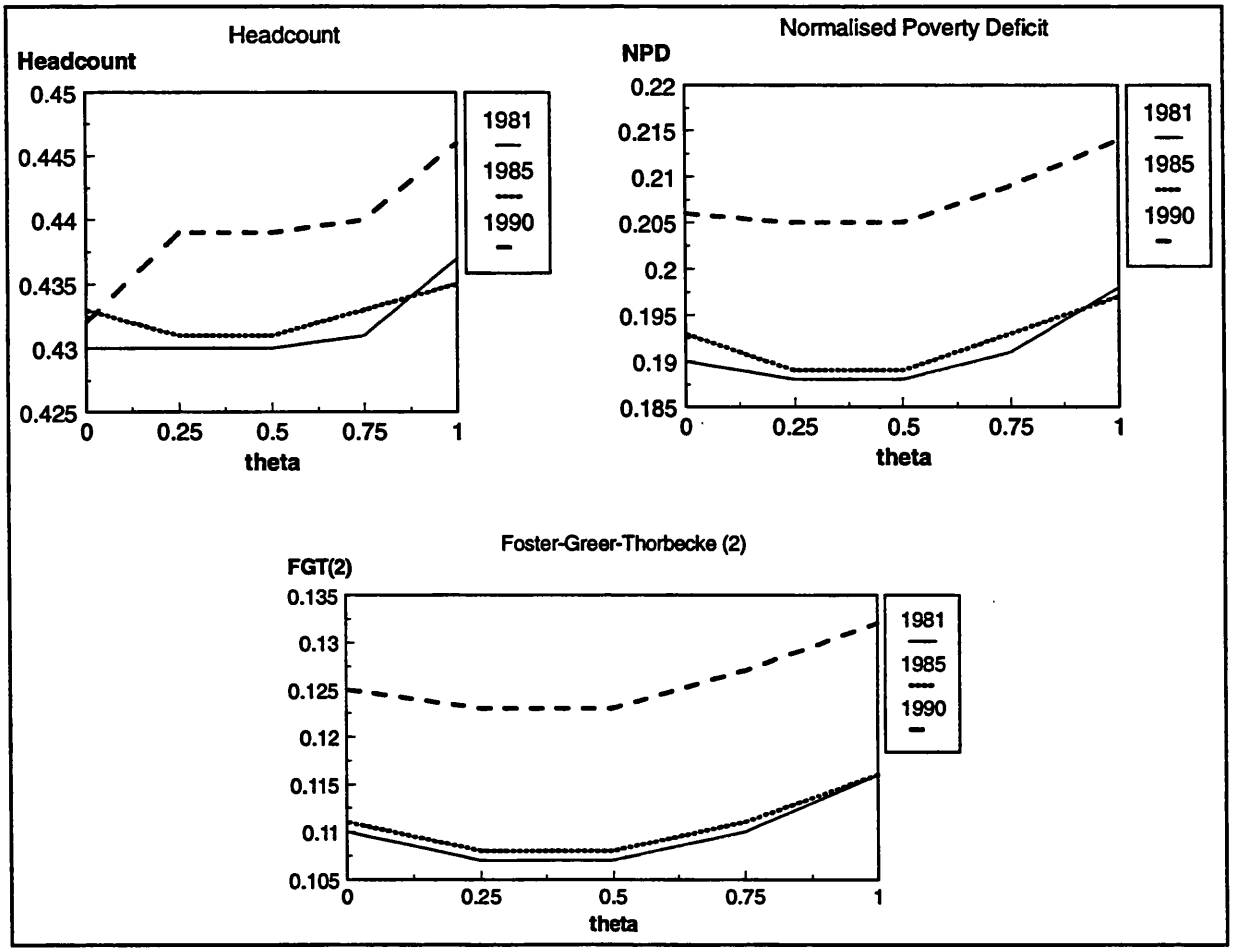

Figure 6: Relative Poverty Measures and the Equivalence Scale: 1981,1985 and 1990.

In addition, it is noteworthy that the monotonicity with which the indices vary with theta is at odds with the stylised U-shaped curve found by Coulter et al (1992a) for the UK and by Rodrigues (1993) for Portugal. Coulter et al (1992a) propose that the U-shaped curve observed in their data set is likely to be the result of the varying relative strengths of two effects: a concentration effect which should cause the index I to fall with θ when the correlation between household income and size is positive, and a re-ranking effect which could cause I to rise with θ. The Brazilian pictures suggest that the re-ranking effect of varying θ might be outweighing the concentration effect. One plausible reason for this is that the correlation between household size and income in Brazil[28] is likely to be much lower than in Europe, given the concentration of very large families amongst poorer households.

The third point relates to the Figure 6, and the fact that trends in poverty are less clear than those for inequality, as discussed in Section 5.2. This is particularly true between 1981 and 1985. 1990 does appear to have greater poverty than the other two years. In fact, poverty is greater for 1990 than for 1981 for all three measures, for all values of theta, which strengthens the conclusion of §5.2 that poverty worsened from the beginning to the end of the decade, despite behaving more cyclically than inequality. Poverty is also greater in 1990 than in 1985 for all measures for all values of theta, except for the headcount with $\theta = 0$.[29] But despite the relatively clear results for 1990, the choice of equivalence scale, which did not affect the picture of inequality trends at all, does appear to matter for the study of poverty trends. In particular, $\theta = 1$ ranks 1981 and 1985 in the opposite way to the other four values of theta both for the headcount and the normalised poverty deficit, and fails to rank them in the case of FGT ($\alpha = 2$). This is cause for some concern, since $\theta = 1$ is equivalent to per capita income, the commonest choice of equivalence scale in works on Brazil.

Fourth, these poverty findings confirm the general conclusions of Coulter et al (1992a) as regards the widely different effects of varying the equivalence scale on poverty analysis

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[28] The correlation coefficient between household size and household income in our sample was 0.033 in 1981, 0.004 in 1985 and 0.007 in 1990.

[29] Given the pattern of all poverty measures with respect to theta revealed by Figure 6, the value of the 1990 headcount for $\theta = 0$ appears slightly suspect. The computations were rechecked, and it seems to be correct.

for absolute poverty lines vis-a-vis relative poverty lines. For fixed, absolute poverty lines defined, as by Rocha (1993), in terms of per capita income, a move to take account of household scale economies (i.e. lowering theta) is bound to lower any measure of poverty substantially. It is only when the poverty line itself is allowed to change in response to the change in the vector of equivalised incomes, that the U-curve obtained both by the aforementioned authors and in this chapter may arise. Indeed, as Figure 6 illustrates, when measuring poverty relative to a line defined as 84% of the median income in the relevant vector, I obtain U-curves for the behaviour of all poverty measures with respect to changes in theta, except for the headcount in 1981 and 1990.

In conclusion, examining the sensitivity of the poverty and inequality measures used in this chapter to the choice of equivalence scales yields a number of interesting insights. The reassuring news is that the inequality trends, which were quite marked both in terms of scalar measures for per capita income and in terms of Lorenz dominance, are robust to the choice of equivalence scales. The cautionary news is that using per capita income can lead to re-rankings for some poverty measures, if their values are not substantially different. And the intriguing news, begging further thought and research, is that although Brazilian data conforms to the stylized U-shaped curve of relative poverty measures when plotted against theta, this is not the case for any of the four inequality measures studied. A tentative suggestion was that this may be due to a much lower correlation between household income and size in Brazil than in other countries for which studies are available.

7) Conclusions.

This chapter presented the results of the analysis of the evolution of the distribution of income in Brazil during the 1980s, based on the PNAD data set. I argued that despite a number of likely income reporting problems, not entirely unusual but perhaps exacerbated by questionnaire design, this data set provided the best available source for insights into the behaviour of income distribution in that turbulent decade. This is due principally to its very large sample size, national representativeness and annual periodicity. The main findings relate to inequality, poverty and welfare.

Inequality increased unambiguously, although not monotonically, in Brazil during the

1980s. This trend was evident from the evolution of scalar measures, whether they were more sensitive to the bottom (e.g. the Theil index), the middle (e.g. the Gini coefficient) or the top of the distribution (e.g. the coefficient of variation). It was confirmed by an examination of decile shares, whence it was observed that the two richest deciles gained income share at the expense of the poorest eight. And it was sharply brought out by the Lorenz dominance analysis, which revealed that all years from 1981 to 1987 displayed mean-normalized second order stochastic dominance over 1988, 1989 and 1990. This implies that any inequality measure satisfying the anonymity axiom and the Pigou-Dalton transfer principle would indicate a rise in inequality in Brazil from the beginning to the end of the decade. Furthermore, this trend appears to be robust to the choice of equivalence scale used.

Poverty also increased in the period, although its behaviour was characterized by wider fluctuations, and these appeared to be driven by the level of economic activity to a greater degree than in the case of inequality. All three measures of poverty rose substantially with the recession of the early eighties, falling with subsequent growth and plummeting to much lower levels during the low-inflation boom of 1986. That year displayed poverty mixed dominance over every other year in the period. Poverty grew again with the return of inflation and the deceleration of growth after 1986, reaching 'twin peaks' in 1988 and 1990. Although 1981 does not dominate 1990 according to the demanding criterion used, 1988 and 1990 were the years most often dominated by other years in the sample. Mean decile incomes were lower in 1990 than in 1981 for the bottom three deciles, and 1990 had greater poverty than either 1981 or 1985, according to all measures for all tested values of the equivalence scale parameter theta, with only one exception.

Whilst I focused on inequality and poverty comparisons, some of the analysis lends itself to interpretation in terms of general social welfare. Relying on the Saposnik and Shorrocks theorems mentioned in Section 2, it can be stated that most social welfare functions would rank social welfare in Brazil as unambiguously lower in 1983 and 1984 than in 1981, or in 1988 and 1990 than in 1989, or indeed in every other year in the decade than in 1986. The social welfare dominance of 1986 over every other year is a remarkable result, particularly as that year combined strong growth with a stabilization plan that temporarily reduced inflation to levels unprecedented in the decade. I return to possible links in the next chapter.

Welfare comparisons between the beginning and the end of the period of study are ambiguous. This ambiguity is due to the fact that growth in the overall mean reported income was offset by greater inequality, causing welfare to fall for the poorest quarter (or so) and to rise for the richest two-thirds (or so) of the population. If the growth implied by the household survey data is exaggerated - as suggested by the picture of stagnation revealed by the national accounts data reported in Chapter 6 - then these welfare results are upper bound, and losses are likely to extend further up than the 26th percentile of the distribution.[30] The poverty results would be similarly affected, with the trend just described possibly underestimating the increases in poverty during the decade.

Even in the absence of a downward revision in the growth rates implicit in the PNAD data, the 1980s were a bad decade for equity in Brazil, with rises in both poverty and inequality. Since this analysis relied on data in which there was growth in average income, it is increased dispersion that lies behind welfare losses for the most vulnerable households in society, and is of particular concern. Policy omission of the type modelled earlier in this thesis might account for some of this increase but, as suggested earlier, the available data is not suitable for testing this hypothesis. The next chapter relies instead on a combination of decomposition analysis and some simple regressions to investigate a number of factors possibly associated with the observed increase in inequality.

[30] See discussion in Section 3.

CHAPTER 8

GROWING APART: MICRO AND MACROECONOMIC FACTORS BEHIND THE TRENDS.

Abstract: This chapter investigates a number of possible explanations for the inequality and poverty trends identified for Brazil in the 1980s by the previous chapter. While the static decompositions of inequality by household characteristics reveal that education, race and geographic location can account for a substantial proportion of inequality levels, a dynamic decomposition suggests that changes in inequality are not explained by income or allocation effects across these groupings. The analysis then turns to the role of macroeconomic instability, and finds some significant correlation and regression coefficients, which suggest that there appears to be a link between inflation and inequality, while poverty appears to be more strongly driven by real wages, growth and employment.

1) Introduction.

Chapter 7 provided a detailed description of what was happening to the distribution of income and to poverty in Brazil in the 1980s. It presented a picture of significant increases in inequality throughout the decade. Apart from being important in their own right, these increases more than offset whatever growth there was in the period, causing poverty to rise as well, albeit with sharp cyclical fluctuations. This chapter seeks to suggest some possible explanations for the secular increase in inequality, by means of some standard decomposition analyses and of a simple investigation into links between the behaviour of some key macroeconomic variables, on the one hand, and inequality and poverty on the other.

Section 2 reports on the static inequality decompositions carried out with three inequality measures, for the years 1981, 1985 and 1990. These decompositions follow the method developed by Cowell and Jenkins (1995), and aim to separate total inequality *levels* into its components within and between groups, where the groups are defined by specific household attributes, such as regional location, urban-rural status, or age, gender, race or education of the head. It is hoped that this sheds light on the structure of inequality in the population. Section 3 discusses a dynamic decomposition methodology due to Mookherjee and Shorrocks (1982), which separates *changes* in inequality into components due to changes in the mean incomes of different groups, changes in the composition of these groups, and unexplained changes.

While the results of those two sections provide some insights into the nature of Brazilian inequality, its increase during the 1980s remains mostly unexplained by these conventional techniques. Section 4 then investigates the potential role of changes in macroeconomic aggregates, such as the growth rate, the rate of inflation, the average real wage rate and the rate of unemployment. This is done by means of diagrams, correlation coefficients and OLS regressions which, despite the reduced time-series sample size, reveal some significant correlation and regression coefficients. They suggest that there may be an important link between high and accelerating inflation, and the growth of inequality. Section 5 concludes.

2) Static Decompositions of Brazilian Inequality.[1]

A standard approach to examining the nature of inequality is to analyze the role played by certain individual characteristics, such as age, gender, education and geographic location[2]. Several theories of the distribution of income provide a rationale for investigating personal characteristics like these. Human capital theories stress the role of education, age and experience, in models where individuals maximise utility over the life-cycle by the optimal choice of investments in human capital (Becker, 1965; Mincer, 1958). Other theories incorporate market imperfections. Labour market segmentation and dual-economy models use personal characteristics such as education, gender or geographic location, either as examples of signals which lead to discrimination, or as institutional barriers that prevent access to or mobility between different labour market segments (e.g. Lewis, 1954; Spence, 1973).

There is also empirical support for such partitions, from studies using regression analysis, inequality decomposition or analysis of variance techniques, although income inequality can never be fully explained by such characteristics. A survey of inequality decompositions in developing countries does show that personal attributes can account for large proportions of the dispersion in the distribution of income (Fields, 1980).

The analysis in this chapter concentrates on five attributes of the household: its regional location; its urban/rural status; age of household head[3]; gender of household head; and his or her educational attainment. Decompositions are carried out for three years: 1981, 1985 and 1990. A sixth factor, ethnicity or race, is another important source of inequality. Unfortunately very little data is available on it: in 1981 the race question did not appear on the questionnaire and in 1985 less than 5% of the sample responded to it. Only for the last two or three years of the decade was there a significant response rate to the question,

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[1] Sections 2 and 3 draw heavily on Litchfield (1995).

[2] Whilst it is possible to draw some inferences about the direction of causality between *fixed* attributes, such as gender or race, and incomes, it is difficult to do so between *variable* attributes, such as education, and incomes.

[3] PNAD interviewers were instructed to register as household head the person "responsible for the household or so perceived by the remaining members" (IBGE, 1993, p.16).

so that it is only included in the decomposition analysis for 1990.

The point of the static decompositions of this section is to separate total inequality in the distribution into a component of inequality between the chosen groups (I_B) - the explained component - and the remaining within-group inequality (I_W) - the unexplained component. These groups are defined by each of the attributes listed above; at first each characteristic is considered individually, and then a finer partition is created by incorporating all attributes together, to give a measure of total inequality explained by all household characteristics.

The first partition of the overall distribution by individual attribute was carried out for age. Households were grouped into six categories by age of head: 1) under 25, 2) 25-34, 3) 35-44, 4) 45-54, 5) 55-64 and 6) 65+ years, using an extension of the categorisation in Bonelli and Ramos (1993).[4] The second partition was by educational attainment of household head, based on last completed year of formal schooling. Education was broken into five groups, again borrowing the Bonelli and Ramos (1993) categories, of 1) illiterates - less than one year of schooling, 2) elementary school - 1 to 4 years of schooling, 3) intermediate school - 5 to 8 years of schooling, 4) high school - 9 to 11 years of schooling and 5) college education - 12 or more years of schooling. The third partition was by regional location of the household. States were grouped into the five official, standard geographical regions of Brazil: North, Northeast, Southeast, South and Centre-West. The fourth partition was by whether the household was located in a rural or urban area. The fifth partition was by gender of household head. The last individual partition was for ethnicity, and only applies to 1990. Households were divided into three groups by the declared ethnicity of the household head: 1) whites, 2) black and mixed race, 3) Asian origin.

Unfortunately, many widely used inequality measures are not decomposable, in the sense that overall inequality can not be related consistently to the constituent parts of the distribution. In particular, we are interested in measures where $I_B + I_W = I$. This is not

[4] Bonelli and Ramos (1993) carry out a similar set of decompositions, but only for economically active urban males between the ages of 18 and 65, working for more than 20 hours a week. Their concern is with labour earnings, rather than household incomes.

generally true, for instance, of the Gini coefficient, but it is true of all members of the Generalised Entropy class.[5] A general formula for the class is repeated below:

$$G(\alpha) = \frac{1}{\alpha^2-\alpha}\left[\frac{1}{n}\sum_{i=1}^{n}\left[\frac{y_i}{\mu(y)}\right]^{\alpha}-1\right], \quad \alpha \in \mathbf{R} \tag{1}$$

Because of its decomposability property, which is not shared by the Gini coefficient or by the coefficient of variation in its pure form, members of this class are clearly the most indicated for the analysis in this chapter. I therefore use three measures in the decompositions below: G(0), G(1) and G(2). If $\alpha=0$ then, using l'Hôpital's rule, $G(\alpha)$ can be written as:

$$G(0) = \frac{1}{n}\sum_{i=1}^{n}\log\left[\frac{\mu(y)}{y_i}\right] \tag{2}$$

Similarly, if $\alpha=1$, $G(\alpha)$ can be expressed as:

$$G(1) = \frac{1}{n}\sum_{i=1}^{n}\frac{y_i}{\mu(y)}\log\left[\frac{y_i}{\mu(y)}\right] \tag{3}$$

If $\alpha=2$, equation (1) can be manipulated to be expressed in terms of the coefficient of variation, cv, as $\frac{1}{2}\,cv^2$:

$$G(2) = \frac{1}{2}\left[\frac{1}{\mu(y)}\sqrt{\frac{1}{n}\sum_{i=1}^{n}(y_i-\mu(y))^2}\right]^2 \tag{4}$$

In fact, G(1) is simply the Theil index, and G(2) is a transformation of the coefficient of

[5] See the discussion of the five axioms satisfied by this parametric class, in Chapter 7-2.

variation, both of which were used in Chapter 7. G(0), which has not been introduced before, is also known as the mean log deviation. Table 1 below gives the values for each of these measures for each of the three years analyzed in this chapter.

Table 1: Summary statistics, 1981-1990.

	1981	1985	1990
Mean Income	143	150	164
Median Income	75	74	79
G(0): mean log deviation	0.614	0.649	0.705
G(1): Theil Index	0.647	0.697	0.745
G(2): ½ squared coefficient of variation	1.337	1.627	2.018

Note: all incomes in 1990 US dollars
Source: own calculations from PNAD, 1981-1990.

Some of this information was contained in Chapter 7, and again the upward trend in inequality during the decade is confirmed by all three measures. The values of $G(\alpha)$, $\alpha = 1, 2, 3$, for the entire distribution, are included also for comparison with their values for different subgroups in the partitions below. Tables 2 and 3 present mean incomes, population shares, income shares and values for each of the inequality measures defined above, for each of the subgroups in each partition discussed earlier.

While these tables contain plenty of information, some basic features deserve special mention. The partition by age does not appear to be a very promising candidate for explaining much of the total inequality. The mean incomes per subgroup are fairly close to each other, varying little around the overall mean. Although households headed by the youngest do earn the least, there is no pronounced support for a life-cycle pattern of incomes. This is brought out by the mean incomes of households headed by 35-44 year-olds, in 1981 and 1985 in particular. While one might have expected these heads to be in some of their prime earning years, their household incomes per capita are lower than those of the age-groups immediately next to them. Though newborn children might explain part of this effect, it is doubtful that they account for the whole effect, particularly as most children in Brazil are born to younger household heads. Finally, the values of

Table 2: Summary statistics: by age, education and race of household head, 1981-1990.

	1981						1985						1990					
	μ_j	f_j	v_j	G(2)	G(1)	G(0)	μ_j	f_j	v_j	G(2)	G(1)	G(0)	μ_j	f_j	v_j	G(2)	G(1)	G(0)
Age																		
1	124	0.04	0.03	0.81	0.45	0.43	120	0.04	0.03	0.96	0.51	0.48	126	0.04	0.03	1.36	0.61	0.56
2	148	0.22	0.23	1.17	0.63	0.62	153	0.23	0.23	1.32	0.65	0.64	156	0.22	0.21	1.54	0.69	0.68
3	127	0.28	0.25	1.38	0.67	0.64	145	0.28	0.27	1.61	0.73	0.70	163	0.29	0.28	1.67	0.74	0.73
4	146	0.24	0.24	1.32	0.63	0.60	150	0.23	0.22	1.63	0.70	0.65	169	0.22	0.23	1.67	0.72	0.70
5	161	0.13	0.15	1.38	0.65	0.61	168	0.14	0.15	1.93	0.71	0.63	182	0.14	0.15	1.71	0.74	0.70
6	151	0.08	0.09	1.65	0.70	0.61	151	0.09	0.09	2.01	0.75	0.63	165	0.10	0.10	5.41	0.94	0.73
Education																		
1	59	0.30	0.13	0.71	0.39	0.38	56	0.29	0.11	0.65	0.38	0.37	57	0.25	0.09	1.33	0.45	0.42
2	109	0.46	0.35	0.71	0.41	0.41	110	0.43	0.31	1.05	0.46	0.43	114	0.40	0.28	1.08	0.50	0.47
3	185	0.14	0.18	0.80	0.43	0.40	176	0.16	0.18	0.84	0.44	0.41	168	0.18	0.18	2.26	0.52	0.45
4	327	0.06	0.14	0.53	0.35	0.36	310	0.08	0.16	0.65	0.38	0.37	298	0.10	0.19	0.79	0.44	0.43
5	622	0.05	0.21	0.39	0.28	0.29	649	0.06	0.24	0.53	0.33	0.32	665	0.07	0.27	0.62	0.36	0.35
Race																		
1													220	0.54	0.73	1.73	0.68	0.66
2													93	0.45	0.26	1.46	0.60	0.56
3													421	0.01	0.02	0.71	0.44	0.47

Notes: μ_j=mean income, f_j=population share, v_j=income share.
all incomes in 1990 US dollars

Source: own calculations from PNAD, 1981-1990.

Table 3: Summary statistics: by geographic location and gender of household head, 1981-1990.

	1981						1985						1990					
	μ_j	f_j	v_j	G(2)	G(1)	G(0)	μ_j	f_j	v_j	G(2)	G(1)	G(0)	μ_j	f_j	v_j	G(2)	G(1)	G(0)
Region																		
SE	190	0.44	0.59	1.06	0.56	0.53	192	0.45	0.57	1.27	0.61	0.57	211	0.45	0.57	1.74	0.64	0.59
S	146	0.16	0.17	1.09	0.55	0.51	164	0.16	0.17	1.49	0.62	0.55	171	0.16	0.16	1.38	0.64	0.60
NE	74	0.30	0.16	1.84	0.68	0.57	78	0.29	0.15	2.29	0.76	0.62	83	0.29	0.15	2.55	0.84	0.70
CW	135	0.07	0.06	1.47	0.65	0.58	159	0.07	0.07	1.80	0.68	0.60	189	0.07	0.08	1.83	0.74	0.68
N	127	0.03	0.02	1.09	0.51	0.44	155	0.03	0.03	1.61	0.60	0.52	175	0.03	0.04	2.48	0.72	0.62
Urban/Rural																		
U	177	0.71	0.88	1.09	0.57	0.54	183	0.73	0.88	1.35	0.62	0.58	200	0.74	0.90	1.71	0.67	0.62
R	59	0.29	0.12	1.64	0.53	0.44	64	0.27	0.12	2.28	0.61	0.50	62	0.26	0.10	1.83	0.59	0.53
Gender																		
M	144	0.89	0.90	1.35	0.65	0.62	153	0.88	0.89	1.61	0.70	0.66	167	0.86	0.87	2.07	0.75	0.71
F	133	0.11	0.10	1.24	0.59	0.55	136	0.12	0.11	1.72	0.67	0.60	149	0.14	0.13	1.59	0.71	0.65

Notes: μ_j=mean income, f_j=population share, v_j=income share.
all incomes in 1990 US dollars
Source: own calculations from PNAD, 1981-1990.

$G(\alpha)$ are fairly close to the overall inequalities reported in Table 1, for all three values of α, suggesting that the between-group component is not likely to be substantial.

The same is true for gender, where values for the three inequality measures for each subgroup were again quite close to - and in some cases greater than - the total inequality values. It should be noted that this result - which will be confirmed by the actual decompositions in Table 4 - is not about earnings inequality between men and women in the labour market. It is based on per capita household incomes, and on a definition of household head which is open to widely different interpretations (see footnote 3). Neither does it contain any information on intra-household allocation of income or resources, so that the fact that gender of household head is unimportant in accounting for inequality should not be interpreted as a statement about either labour market or intra-household discrimination.

The partitions by geographic region and by rural/urban status reveal a grater dispersion of subgroup means around the overall mean, for all years, and generally smaller values for the subgroup inequality measures than for the overall measure. There were exceptions, however, particularly for G(2) in a number of cases, and for the Northeastern region, which had higher values than the whole of Brazil for G(1) and G(2) in all three years.

But it is education that emerges as the attribute most likely to 'explain' some of total inequality. Here we see subgroup means rising monotonically with education, and displaying substantial variation around the overall mean. We also observe subgroup values for all three inequality measures well below those for the whole distribution. While this leads to the expectation that the static decomposition will reveal education as an important 'explanatory' variable, the caution raised in footnote 2 should be borne in mind: education is a variable attribute, and causation can not be inferred to run exclusively from it to the distribution of incomes. It is probably reasonable to expect that the two are determined endogenously and simultaneously, and many models do exist with prominent links between one generation's income and the level of education of the next. Since income is likely to be serially correlated - although the absence of panel data prevents me from testing that hypothesis - caution is certainly warranted in interpreting the importance of education in 'explaining' income inequality.

But while observing subgroup means and inequality measures can be informative, there is a more formal way to appraise the contributions of each of these household attributes to overall inequality. This is through the static decompositions suggested by Cowell and Jenkins (1995), which is described below. When total inequality I, as measured by any of the three indices reported in the foregoing tables, is decomposed by population subgroups, the Generalised Entropy class of measures can be expressed as the sum of within-group inequality, I_W, and between-group inequality, I_B . Within-group inequality, I_W , is calculated and weighted as follows:

$$I_w = \sum_{j=1}^{k} w_j \, G(\alpha)_j \qquad (5)$$
$$w_j = v_j^{\alpha} \, f_j^{1-\alpha}$$

where f_j is the population share and v_j the income share of each subgroup j, $j=1,2,....k$. Between-group inequality, I_B, is measured by assigning the mean income of group j, $\mu(y_j)$ to each member of the group and calculating:

$$I_B = \frac{1}{\alpha^2-\alpha}\left[\sum_{j=1}^{k} f_j \left(\frac{\mu(y_j)}{\mu(y)}\right)^{\alpha} - 1\right] \qquad (6)$$

Cowell and Jenkins (1995) show that the within- and between-group components of inequality, defined as above, can be related to overall inequality in the simplest possible way: $I_B + I_W = I$. They then suggest an intuitive summary measure, R_B , of the amount of inequality explained by a particular characteristic or set of characteristics (i.e. by a partition Π):

$$R_B = \frac{I_B(\Pi)}{I} \qquad (7)$$

This statistic can be interpreted as the share of total inequality which can be 'accounted for' or 'explained' by the attributes defining partition Π. Table 4 below presents values of R_B for partitions by each characteristic discussed earlier, as well as for a finer partition, incorporating all of them together. This is done for each of the three inequality indices

used in this chapter, and for 1981, 1985 and 1990. Clearly, the share of inequality explained by any or all of the household attributes varies according to the measure being decomposed. Just as we focused on the Theil and Gini in Chapter 7, we choose here to focus on G(0) and G(1). The explanatory power of the decompositions is smaller for G(2), which is more sensitive to higher incomes. In discussing the results in Table 4, the range of explanatory powers of each characteristic will be given for G(0) and G(1).

There are five main results from these decompositions: first, the explanatory power of age and gender of the household head is negligible in both cases. Second, inequality between rural and urban areas across the country explains somewhere between 10-17% of total inequality, while inter-regional differences account for 8-12%. Both of these partitions seemed to lose explanatory power with time. Third, the education level of the household head is by far the most important explanatory variable, accounting for up to 42% of total inequality in Brazil on its own. Its importance was relatively stable during the decade. Fourth, race is another important factor, accounting for between 11-13% of total inequality. The difference between the two bottom rows for 1990 shows, however, that although race is not negligible when taken alone, it must be closely correlated as an explanatory factor with some of the other attributes, since the explanatory power of the fine partition hardly changes as a result of its introduction.

Finally, when the five main variables are taken together, so that the distribution is finely partitioned, they jointly account for about half of total observed inequality. This is quite a high proportion, in comparison with many other countries. For the United States, for instance, Cowell and Jenkins (1995) find that gender, age, race and employment status can account for 25% - 33% of total inequality, by the same method as that used here.[6] A similar range is obtained for Portugal, by Rodrigues (1993). Subject to the proviso made above that for variable factors these results can not be used to infer the direction of causation - which is particularly relevant in the case of years of schooling - this is an informative exercise.

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[6] There is a small difference: they use Atkinson indices, rather than members of the Generalized Entropy class. Higher values for R_B are obtained when equivalent - rather than mean - incomes are used to compute between-group inequality. In that case, though, $I_B + I_W \neq I$, so that R_B is no longer the only measure of explanatory power of a partition. Indeed, $R_W = 1 - I_W/I \neq R_B$.

Table 4: The amount of inequality explained: static results.

	1981			1985			1990		
	G(0)	R_B G(1)	G(2)	G(0)	R_B G(1)	G(2)	G(0)	R_B G(1)	G(2)
Age	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Education	0.37	0.42	0.30	0.39	0.42	0.26	0.37	0.40	0.21
Region	0.12	0.10	0.04	0.10	0.08	0.03	0.10	0.08	0.03
Urban/rural	0.17	0.13	0.05	0.14	0.11	0.04	0.10	0.11	0.03
Gender	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Race							0.13	0.11	0.04
All (exc race)	**0.51**	**0.52**	**0.36**	**0.51**	**0.50**	**0.30**	**0.50**	**0.49**	**0.25**
All (inc race)							**0.52**	**0.51**	**0.26**

3) The Dynamic Decomposition of Brazilian Inequality.

However, while we may now feel that we know some of the factors behind the high *levels* of inequality in Brazil, such as educational attainment, geographic location, rural/urban status and race, they do not tell us anything about the reasons behind the *changes* during the 1980s, with which we were concerned in Chapter 7. To investigate whether these household characteristics can help explain those changes, I briefly report results from a dynamic decomposition of G(0), due to Mookherjee and Shorrocks (1982).

Accounting for changes in an overall measure of inequality - such as G(0) - by means of a partition of the distribution into subgroups defined by some household attribute must entail at least two components to the change: one caused by a change in inequality between the groups, and one by a change in inequality within the groups. The first one is naturally the part of the total change 'explained' by the partition, whereas the second is a "pure inequality" or unexplained effect. But the explained component can be further disaggregated into an effect due to changes in relative mean incomes between the subgroups - an "income effect" - and one due to changes in the size or membership of the subgroups - an "allocation effect". The Mookherjee and Shorrocks (1982) procedure captures these three effects in an intuitive way. It allows the change in overall inequality to be decomposed into four terms as follows[7]:

$$\Delta G(0) = \left[\begin{array}{l} \sum_{j=1}^{k} \bar{f}_j \Delta G(0)_j \\ + \sum_{j=1}^{k} \overline{G(0)_j}\ \Delta f_j + \sum_{j=1}^{k} \left[\bar{\lambda}_j - \overline{\log(\lambda_j)} \right] \Delta f_j \\ + \sum_{j=1}^{k} (\bar{v}_j - \bar{f}_j)\ \Delta \log(\mu(y_j)) \end{array} \right] \qquad (8)$$

where Δ is the difference operator, f_j is the population share of group j, λ_j is the mean income of group *j* relative to the overall mean, ie $\mu(y_j)/\mu(y)$, and the overbar indicates a

[7] This is actually an approximation to the true decomposition, but both Mookherjee and Shorrocks (1982) and, later, Jenkins (1995) argue that for computational purposes this approximation is sufficient.

simple average. The first term (a) in equation (8) captures the unexplained, or pure inequality effect. The second and third terms (b and c) capture the allocation effect, holding within-group inequality and relative mean incomes constant in turns. The final term (d) corresponds to the income effect.

By dividing both sides through by $G(0)_t$, proportional changes in overall inequality can be compared to proportional changes in the individual effects (Jenkins, 1995). It is then straightforward to draw conclusions about the importance of each effect in explaining changes in the total. Changes in terms b, c or d indicate the extent to which changes in mean incomes for the different groups, or in their composition, explain the observed changes in total G(0). Changes in the first component - the pure inequality effect - are the unexplained changes, due to greater inequality within the groups. Results for changes between 1981 and 1990 are reported in Table 5 below.

Table 5: The amount of inequality explained: dynamic results

% change in G(0) 1981-1990		14.8		
% accounted for by:	**a**	**b**	**c**	**d**
Age	14.9	0.1	0.0	-0.2
Education	10.0	-0.5	4.5	0.9
Region	15.2	-0.1	-0.2	-0.1
Urban/rural	14.2	0.5	-1.5	1.7
Gender	15.0	-0.3	0.0	0.1

Notes: a shows the pure within-group inequality effect
b and c show the allocation effect
d shows the income effect

Some 5% of the total rise in inequality can be jointly accounted for by increases in mean income differences between urban and rural areas, and by offsetting migration. A more significant 33% is 'explained' by reallocation and income effects across education groups. The striking feature of the table, nevertheless, is the dominance of component 'a' over all others. With the exception of education and urban/rural status, the within-group, 'pure inequality' effect was actually larger for the partitions than the observed proportional

change in G(0) for the complete distribution. This suggests that changes in composition or relative incomes of groups defined by age, region or gender did not contribute towards the increase in overall income inequality observed in Brazil from the beginning to the end of the 1980s.

Even in the cases of education and urban/rural status, the unexplained component is still larger than the combination of the income and allocation effects. It therefore appears that most of the growth in inequality observed in the 1980s can not be explained by changes in inequality between the groups partitioned according to the attributes in the above table.

Since ten years is a relatively short time in terms of a structural transformation of earnings behaviour, this is perhaps not surprising. But the question remains as to what lies behind the significant increases in inequality that were registered both in terms of Lorenz dominance and in terms of all scalar measures reported, which we now know to consist mostly of unexplained within-group effects. Standard approaches to explaining changes in the income distribution often stop at this point, and pursue the question no further. The task is not made easier for this chapter by the small number of observations in our time-series. Nevertheless, the next section presents the results of a tentative investigation into possible links between elements of the macroeconomic instability described in Chapter 6, and the behaviour of inequality and poverty.

4) The Impact of Macroeconomic Performance.

The theory put forward earlier in this thesis focused on the effects of government investment on long-term inequality trends, rather than on the impacts of government macroeconomic management on short-term inequality trends. Because our data set was not suitable to an investigation of long term trends, with special reference to partitions by use of public or private services, it was used instead to produce a description of the basic pictures of inequality and poverty, focusing on short-term trends. Whereas Chapter 7 presented these pictures, this chapter has tried to explain them.

While the static decomposition analysis of Section 2 shed some light on the structure of inequality by household attributes, the dynamic decompositions were incapable of explaining much of the *change* in inequality. This section changes the line of approach

somewhat, and seeks to investigate whether there are any suggestive relationships between macroeconomic variables and inequality (and poverty). It does so without proposing a formal theoretical framework to underlie them, but the alternative at this stage was to leave the trends detected and described in Chapter 7 unexplained. This section therefore presents some diagrams and correlation coefficients, as well as some time-series OLS regression coefficients. In the absence of a proper theoretical model, and given the limitations of the time-series data, I make no claim that these establish causation.

The discussion below is intended as a first step in coming to grips with suggestive evidence that at least some of the (hitherto unexplained) increase in inequality in the decade was linked to macroeconomic instability, particularly inflation. A slightly different picture emerges for poverty, which is in line with its more cyclical behaviour. Most of the discussion in this last section can be seen as motivating the need for further research into the interplay between macroeconomics and inequality in Brazil.

Figure 1 plots inflation and unemployment alongside the Theil index over time. Figures 2 and 3 do the same for real wages in manufacturing and annual growth in GDP. Figures 4, 5 and 6 repeat the previous three, replacing inequality (the Theil) with poverty (FGT2). In each of these figures, the macroeconomic variables are measured along the left-hand scale and the inequality or poverty indices are measured along the right-hand scale. Table 6 below reports Rank-Spearman Correlation coefficients between the Theil index and the four macro variables, and between the FGT(2) poverty measure and the same variables.

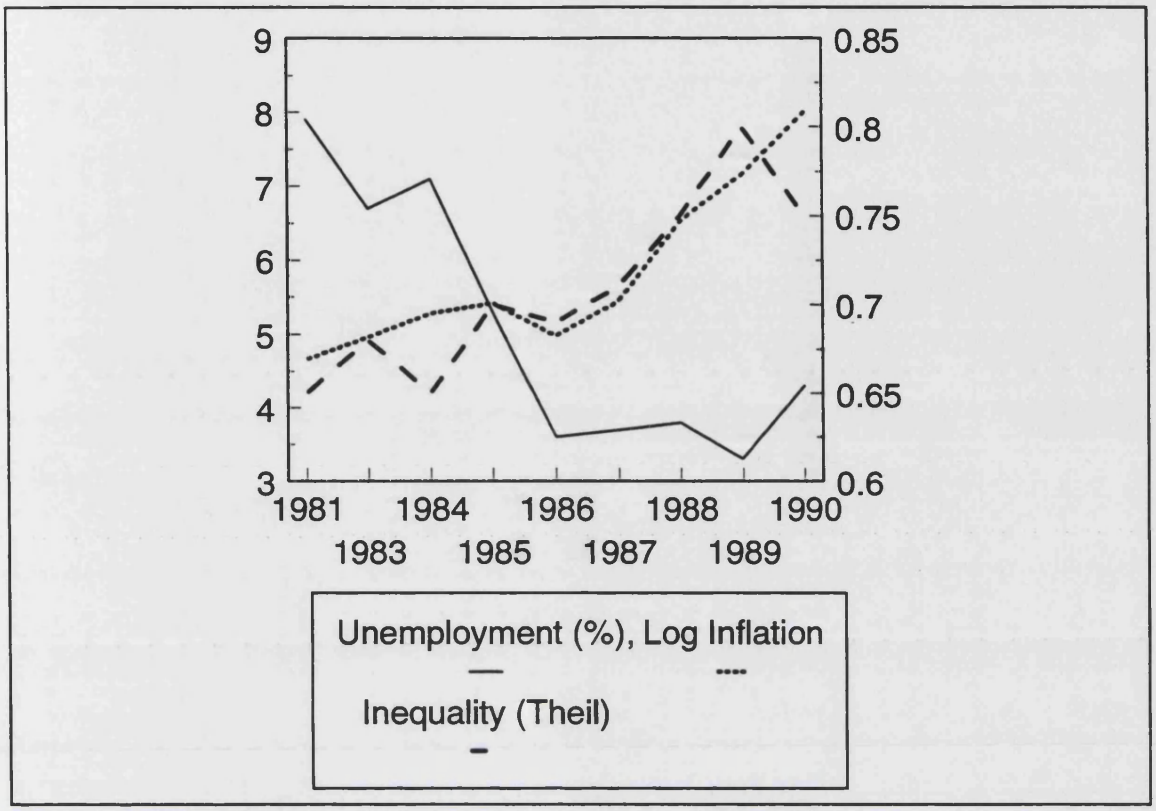

Figure 1: Unemployment, inflation and inequality, 1981-1990

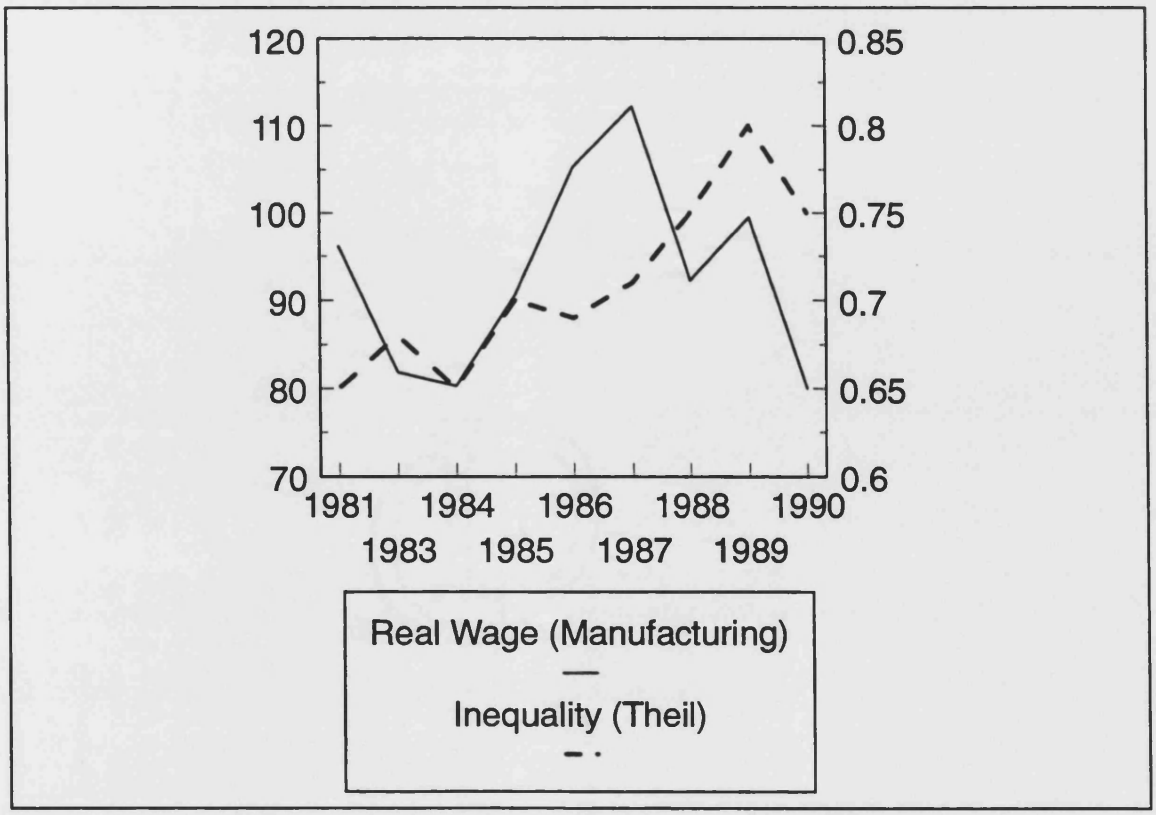

Figure 2: Real wages in manufacturing and inequality, 1981-1990

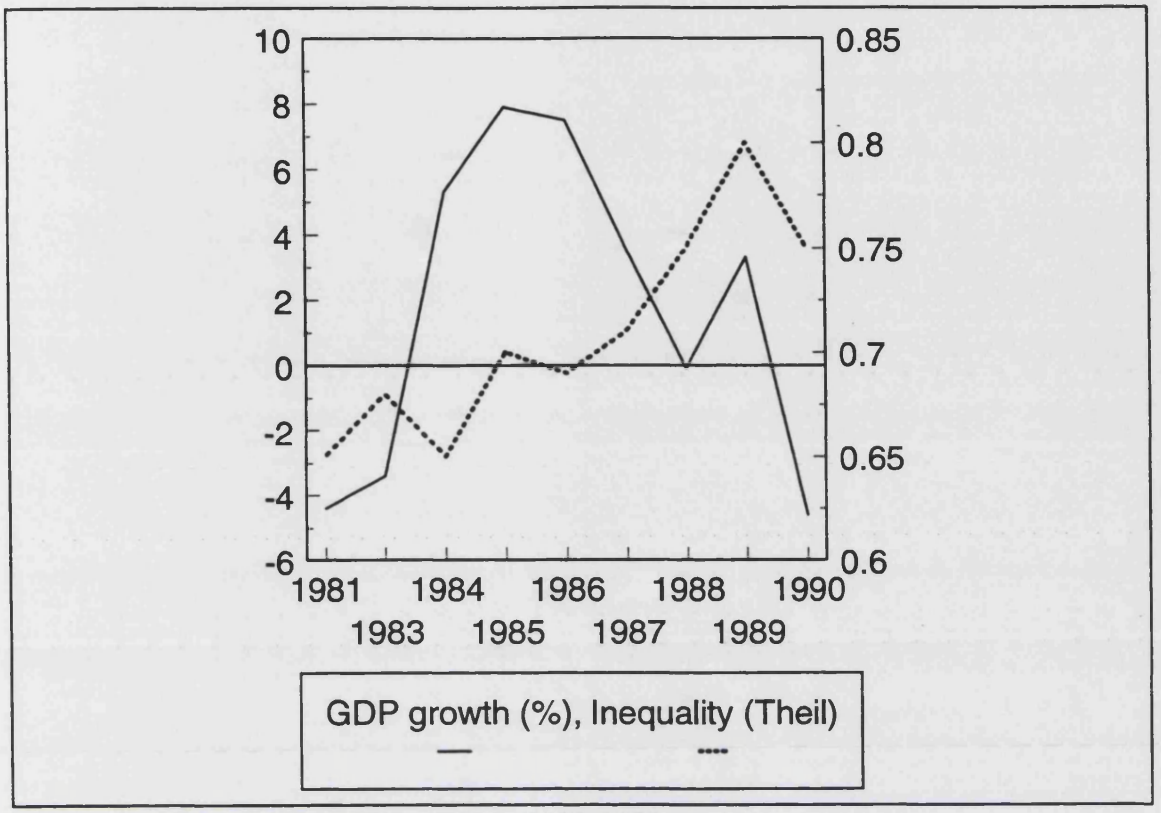

Figure 3: GDP growth and inequality, 1981-1990

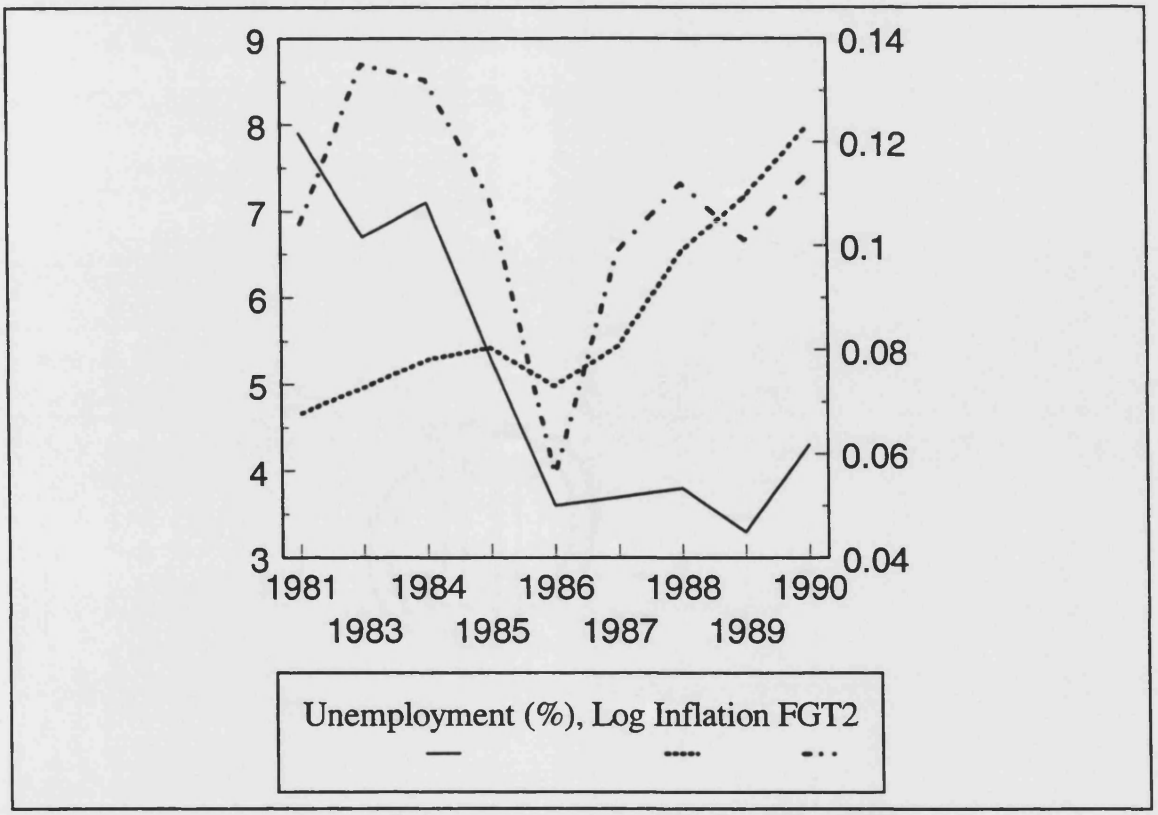

Figure 4: Unemployment, inflation and poverty (FGT2), 1981-1990

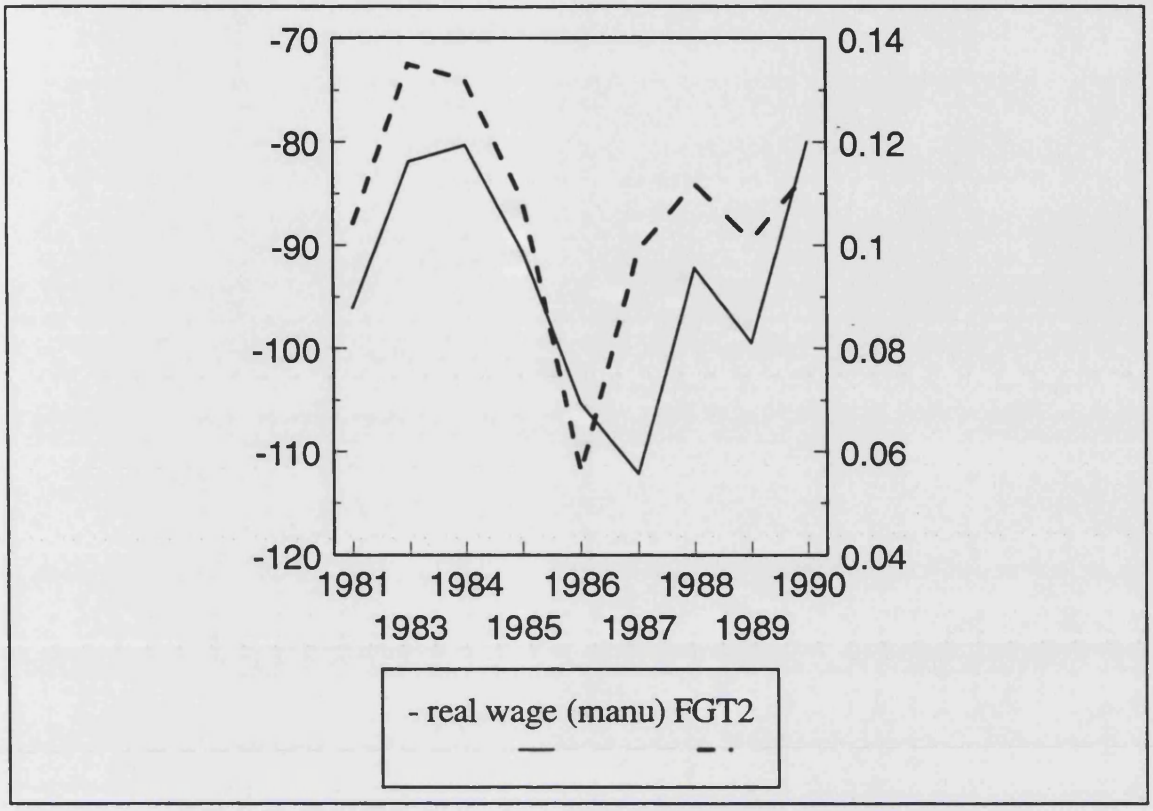

Figure 5: (Minus) Real wages (manufacturing) and poverty (FGT2), 1981-1990

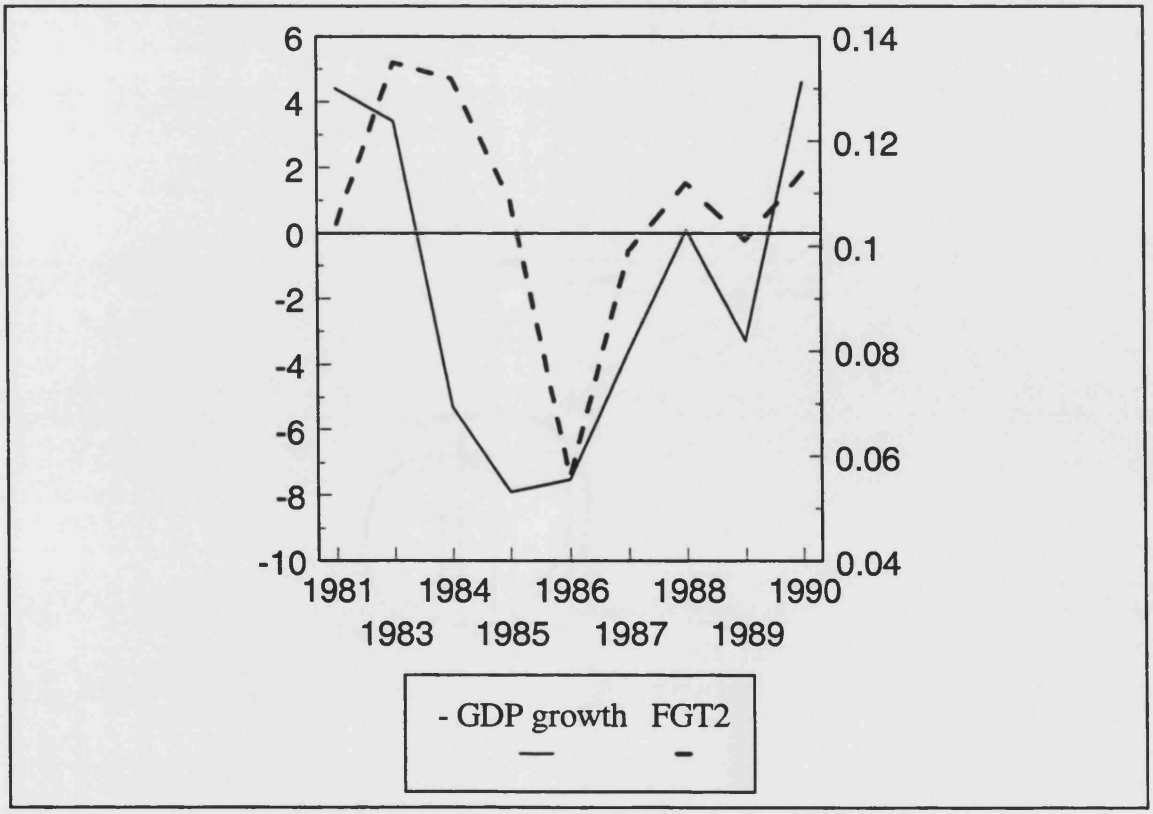

Figure 6: (Minus) GDP growth and poverty (FGT2), 1981-1990

Table 6: Correlation coefficients

	Theil index	**FGT(2)**
Log inflation	0.8455*	0.1038
Unemployment	-0.7986*	0.5432
Real Wage in Manufacturing	0.1592	-0.7484*
GDP growth	0.0123	-0.4349

Notes: Macroeconomic variables time-series from table 1.
* denotes coefficients statistically significantly different from zero at the 5% level.

It would appear from this initial visualization of the data that, while both poverty and inequality grew over the decade, the changes in poverty and inequality were driven by different forces. It is striking, for instance, that the signs on the correlation coefficients between the Theil and both unemployment and real wages have the 'wrong' sign. Higher unemployment was associated, in Brazil in the 1980s, with lower inequality and, despite the reduced number of observations, this negative correlation was significant. Lower real wages were also associated with lower inequality, although not significantly. Interestingly, the correlation coefficient between growth and inequality was very close to zero. The real macroeconomic force behind growth in inequality would appear to be inflation, as Figure 1 and Table 7 suggest. A reason for this has been suggested before, namely the fact that ability to hedge against inflation - i.e to protect the value of one's earnings and assets - is widely thought to be positively related to income. Or in other words, that the inflation tax is a highly regressive means of financing a public deficit.

Since this dispersionary effect of high inflation is also felt within all partition groupings in Table 5 above, it may provide a candidate explanation for the large unexplained component in changes in inequality. Given the results of the dynamic decomposition reported in Section 3, it is clear that structural changes in incomes accruing to groups

partitioned by age, gender, geographic location and even education, or in their composition, do not account for much of the increase in inequality documented in Chapter 7. In that light, a correlation coefficient of 0.85 between the Theil index and inflation, significant despite the very few observations, appears to warrant some consideration. As the brief historical discussion in Chapter 6 highlighted, high and unstable inflation was perhaps the single most notable feature of the Brazilian macroeconomic scenario throughout the 1980s. Its growth and fluctuations are closely matched by those of inequality, as can be seen by Figure 1. Whatever future empirical findings on the role of government investment in influencing long-term distributional trends might be, it would seem that some attention might productively be paid to monitoring the impact of short-term macroeconomic mismanagement on short-term equity.

These tentative results are starkly at odds with the traditional view that unemployment has an inequality augmenting effect, while inflation has an (insignificant) equalizing effect, as reported for the cases of the US by Blinder and Esaki (1978) and of the UK by Nolan (1987). It may be the case that whereas in low inflation economies, an increase in inflation merely proxies for an increase in aggregate demand, leading to higher (expected) wages for the bottom of the distribution, in high inflation economies such as Brazil, the regressive effect of the inflation tax dominates.

The relation between poverty and the macroeconomic aggregates is rather different. The effect of inflation is still positive, but not large, while unemployment and real wages now have the expected signs. Falls in unemployment, rises in real wages and rises in GDP growth are all correlated with reductions in poverty. Indeed, the real wages index was the only variable to be significantly (negatively) correlated with the FGT(2) poverty measure.

This preliminary evidence seemed to justify further investigation, by means of a set of OLS regressions, run with the time series data used to compute the correlation coefficients above. Unfortunately, since 1982 was excluded from the PNAD sample[8], the time-series sample is very small, with only 9 observations. This adds to the list of reasons for caution in interpreting the results in this section. It also restricts the number of explanatory variables to be included in each regression. To retain enough degrees of freedom (and

[8] See Chapter 7-3.

reduce multicollinearity) to allow for any results to be significant, I restricted the models to be estimated to the two specifications below. Both focus on the effects of unemployment and inflation - the two variables significantly correlated with inequality - and exclude other potential regressors.

The first model is given by:

$$y_t = \alpha + \beta_1 UE_t + \beta_2 IF_t + u_t \qquad (9)$$

where the dependent variable y_t is either the Theil Index or the Foster-Greer-Thorbecke (α=2) at time t, UE is the rate of unemployment (percent) and IF is the logarithm of the rate of inflation (percent). The second model was designed to replicate the Blinder and Esaki (1978) approach[9], which was also applied to UK data by Nolan (1987). It is given by:

$$s_{it} = \alpha_i + \beta_{1i} UE_t + \beta_{2i} IF_t + u_{it} \qquad (10)$$

where s_{it} denotes the income share of the i^{th} decile in year t, and the regressors are the same as in (9). The subscript i associated with the intercept and the coefficients indicates that these are being estimated separately for each decile. The ten decile share regressions are in fact a set of 'seemingly unrelated regressions' (Zellner, 1962), but since the right-hand-side variables are the same in each equation, the SURE estimation technique suggested by Zellner is equivalent to the OLS procedure, which is used to estimate the equations. See Nolan (1987) for details of the approach. Table 7 below presents the basic OLS estimation results for (9) and (10).

[9] There are two small differences between their formulation and mine. First, their dependent variables are quintile shares, whereas I use decile shares, for the sake of consistency with the presentation of results in Chapter 7. Second, they include a time trend as a regressor. This was done for our data, and the results were similar in nature to those presented below, but there was considerable cost, in terms of significance, from losing a precious degree of freedom and introducing some multicollinearity.

Table 7: OLS Regression Results

OLS Estimation of Model (9)

y	$\hat{\beta}_1$	$\hat{\beta}_2$	R^2	Durbin-Watson
Theil Index	-0.0144149**	0.0232029**	0.8782[ff]	2.228[a]
FGT(2)	0.0117573**	0.0123453	0.5492	2.211[a]

OLS Estimation of Model (10)

Decile	$\hat{\beta}_1$	$\hat{\beta}_2$	R^2	Durbin-Watson
1	0.0286084	-0.0632042**	0.7872[ff]	1.547[b]
2	0.0338672*	-0.0885136**	0.8684[ff]	2.024[a]
3	0.0280904	-0.1120901**	0.8363[ff]	2.189[a]
4	0.0319507	-0.1291567**	0.8362[ff]	2.208[a]
5	0.0279158	-0.1263449**	0.7515[f]	2.249[a]
6	0.0164597	-0.1365249**	0.7338[f]	2.295[a]
7	0.0234257	-0.1207190**	0.7349[f]	2.145[a]
8	0.0389421	-0.0539906	0.6900[f]	2.265[a]
9	0.0772234*	0.0484333	0.4873	2.908[b]
10	-0.3046318	0.7792771**	0.8297[ff]	1.971[a]

Notes: * denotes statistically significantly different from zero at the 10% level.
** denotes statistically significantly different from zero at the 5% level.
a: The Durbin-Watson test (5%level) fails to reject the no autocorrelation hypothesis.
b: The Durbin-Watson test statistic is in the inconclusive range. (For n=9, k=2, d_L=0.629, d_U=1.699)
f: The F test for the joint significance fails to reject the null of the no joint significance at the 5% level.
ff: The F test fails to reject the null at the 1% level.

These regressions add strength to the suggestion that macroeconomic instability was an important factor behind the increase in Brazilian inequality in the 1980s. The Durbin-Watson test for residual autocorrelation generally fails to reject the null hypothesis that the problem is not present, which eliminates the most likely cause of bias in the coefficients. The R^2 values are sufficiently large that the F-test for joint significance rejects the null hypothesis of no relation at the 5% level for nine out of the ten decile

regressions. For the bottom four deciles and the top one, the F-test rejects the null at the 1% level, as it does for the inequality version of model (9). There are also a number of individual coefficients which are significantly different from zero at the 5% level (Student's t test).

More specifically, there is substantial backing for the hypothesis that high inflation may have contributed to the rise in inequality - through the regressivity of the inflation tax. The first equation of model (9), whose joint explanatory power is significant at the 1% level, confirms the positive coefficient of inflation, which is significant at the 5% level. (So is the counter-intuitive negative coefficient of unemployment, to which I turn next.) The Blinder-Esaki equations in model (10) are even more revealing. The coefficients in these ten regressions suggest that the impact of inflation, *ceteris paribus*, would have been to reduce the shares of the bottom eight deciles of the distribution, and to raise the shares of the top two. But as we know from Table 7-7, this is precisely what happened to the Brazilian distribution from 1981 to 1990: the richest two deciles gained income share at the expense of the bottom eight. And, despite the small sample size, the inflation coefficients are significant (at the 5% level) for the bottom seven and the top one deciles.

By contributing to a reduction in the income shares of the poor, inflation should clearly have a positive impact on any measure of poverty as well. This is confirmed by the sign of its coefficient in the second version of model (9). There is also confirmation, however, of the hypothesis that inflation and unemployment are less closely related to poverty than to inequality: the F-test for this regression fails to reject the null hypothesis of no relation at the 5% level. This might have been expected, since the real wage index, which had the only significant correlation coefficient with FGT(2), was not included in this regression.[10]

What about the effects of unemployment? The conventional wisdom has been to expect unemployment to be positively related to inequality and to poverty. This is the case in most countries. As Nolan (1987) states:

> "These results [for the US, the UK and Canada] are in line with the a priori expectation that unemployment reduces the share of the bottom groups." (p.21).

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[10] This exclusion was motivated by the small sample size and for comparability across the models.

In the case of Brazil, however, the opposite result is obtained on two counts: although unemployment is positively (and significantly) related with poverty, it is negatively related with inequality. And it seems to increase the shares of the bottom nine deciles, at the expense of the richest one.[11]

There are two possible explanations for this counter-intuitive phenomenon. The first is that the macroeconomic history of the decade was such that unemployment and inflation were negatively correlated between themselves (as inflation rose during the decade, unemployment fell), and that the apparent positive effect of unemployment on the shares of the poor is capturing some of the real (negative) effect of inflation. This argument is reinforced by the fact that when unemployment and inflation are included together in the decile regressions, the inflation coefficients are generally significant (eight of them at the 5% level), whereas the unemployment coefficients are not. This suggests that the real macroeconomic culprit for increasing inequality is inflation, and that the positive coefficient of unemployment on the FGT(2) regression of model (9) - which is significant - is a better guide to the effects of unemployment on the poor than the (insignificant) positive coefficients in the decile share regressions.

The second candidate explanation is that unemployment in Brazil - and possibly in other developing countries with large informal sectors and undeveloped social safety nets - is not a labour status likely to be reported by the very poorest. They may respond to negative labour demand shocks by retreating to an informal sector characterised by self-employment with low productivity rates, or by employment at flexible wages. This is the view of unemployment as a 'luxury' which the very poor in a developing country can not afford. Further empirical investigation of this possibility is outside the scope of this section, but if it were found to contain some truth, this may also help explain the correlation between reductions in unemployment and income share losses by the poor. It may even be that the direction of causation is reversed, with greater poverty meaning that some people can no longer afford to remain unemployed - in which state the expected present discounted value of their future search prospects may be higher - and must move

[11] Note the apparent contradiction between this result and the positive coefficient of unemployment in the regression of FGT(2), model (9): unemployment significantly increases poverty, whilst appearing to make the poor relatively better off!

to a (lower utility) informal sector employment.

While this section has raised some new questions, it has also pointed to at least one important candidate answer. The results presented in Section 3 indicate that the structural or microeconomic factors usually included in dynamic inequality decompositions can not account for much of the changes in this period. This section has presented some evidence that macroeconomic factors, and inflation in particular, may be behind the increase in dispersion in Brazil. Poverty, on the other hand, appears to be more closely related to real wages, unemployment and growth. There appears to be scope for future work, both theoretical and empirical, on the effects of inflation and unemployment on the distribution of household equivalised income.

5) Conclusions.

This chapter has sought to explain the Brazilian inequality and poverty trends identified in Chapter 7. To do so, it relied on a mixture of conventional decomposition techniques, which focus on more microeconomic or structural factors, and a simple econometric analysis of the role of macroeconomic variables. Whereas the decompositions partition the distribution according to various characteristics of the household, such as geographic location and head's age, gender, race or education, the econometric estimations look for relationships between inequality and poverty measures on the one hand, and macroeconomic indicators such as inflation and unemployment on the other.

The static decomposition method, due to Cowell and Jenkins (1995), revealed that the set of household attributes described above, taken together, was capable of 'explaining' about half of overall inequality as 'between groups'. Taken individually, education was the most important explanatory factor, accounting for 37-42% of overall dispersion on its own. Causality can not be inferred, but the finding is descriptively significant. Race, regional location and urban/rural status also accounted for some 10% of total inequality, but age and gender of head were unimportant as sources of inequality.

While some light was thereby shed on the *structure* of Brazilian inequality, partitions by household characteristics were less successful in explaining *changes* in the distribution. The dynamic decomposition due to Mookherjee and Shorrocks (1982) found that changes

in the composition of education groupings - notably an increase in the numbers of intermediate and high-school graduates - had some impact on the overall increase in inequality. But its main result was that most of the increase in overall inequality between 1981 and 1990 was due to an unexplained, 'pure inequality' effect.

This result prompted consideration of a different set of possible factors influencing the income distribution: macroeconomic fluctuations. Although these factors had been considered before, the case of Brazil is an interesting one because of the extent of the macroeconomic instability it experienced in the 1980s. This part of the analysis was more tentative, due both to the absence of an underlying theoretical framework and to the reduced time-series sample size. Nevertheless, there was some significant evidence that increases in (an already high) level of inflation are correlated with, and may be partly responsible for, increases in inequality.

The analysis in this chapter is more ambiguous about the effects of unemployment on income dispersion, although it appears to be significantly related to increases in absolute poverty. Poverty also appears to increase with inflation, albeit less markedly and less significantly. Bivariate correlation coefficients suggest that real wage cuts and reductions in economic growth also appear to have an impact on poverty. While the analysis of macroeconomic factors behind inequality and poverty trends in this chapter was tentative, it does appear to signal an area for potentially fruitful future research, at least in the case of Brazil.

CHAPTER 9

CONCLUSIONS

This thesis has been about the effects of structural adjustment on income distribution, with a particular focus on the role of government. The eight preceding chapters fall into three parts: the introductory 'institutional' part comprised Chapters 1 and 2; Chapters 3, 4 and 5 formed the theoretical part; and the empirical part consisted of the last three chapters. Each of the main chapters had its own concluding section, where the principal findings and results were reviewed, eliminating the need for a lengthy final chapter. The purpose of this section is to bring together the main conclusions from the different parts of the thesis.

In the first part, Chapter 1 reviewed the general background to structural adjustment. It stressed the importance of the oil price shocks of the 1970s as a medium-term cause, because of the sharp realignment of the international terms of trade they brought about. It was this original shock that many developing countries did not *adjust* to. Borrowing in the international financial markets allowed them to maintain a gap between domestic expenditure and income, which translated into large current account deficits. The debt crisis of the early 1980s was the collapse of that system of financing, and led to the need for sharp domestic macroeconomic responses. These consisted essentially of expenditure reduction policies, generally through cuts in public sector expenditure and borrowing, and expenditure switching policies, generally through a real devaluation.

The chapter discussed the nature of these policies, and the difference between them and the more complex set of structural, institutional and microeconomic reforms which soon came to accompany them, as the process of adjustment focused on laying the foundations

for sound future growth, by improving the basis of resource allocation. In principle, the combination of stabilization and structural adjustment policies constituted a process of pervasive economic reform, with substantial potential for impact on (both the average level and the distribution of) the incomes accruing to individuals in the adjusting country. Five conceptually distinct channels for this impact were mentioned: relative (goods) price effects, labour market effects, asset price effects, public expenditure effects on entitlements, and long-term effects on capital accumulation. The theoretical analysis in the thesis focused principally on the effects of sustained government expenditure reduction, through the last two channels.

Before that, however, Chapter 2 provided a lengthier discussion of the issues involved in the international debt crisis and the subsequent process of adjustment, by means of a review of the contributions of the World Bank to the study of those topics. It found that the Bank seemed to endorse the high-borrowing strategy of the late 1970s, and did not publicly reveal much concern with mounting debt until after 1982. It also found that the Bank was very hesitant to acknowledge the need for any element of debt forgiveness in its approach to resolving the crisis, until after it was obvious to the informed public. As regards structural adjustment, its more important contributions were to the application of good price and trade theory to the design of structural reforms and post-reform targets, rather than to the macroeconomic aspects associated with the design of stabilization. Despite important data contributions, through LSMS, the Bank was not very original in its approach to understanding the impacts of reform on equity. During most of the decade, its public statements on the issue seemed too reliant on the prospect of future growth as the answer to poverty concerns.

But future growth did not do much for the living standards of the most vulnerable during what turned out to be a considerable medium-term. Many authors, mentioned earlier in the thesis, reported on the seriousness of some impacts from case studies, or modelled the effects through the goods, labour and assets markets. Chapters 3, 4 and 5 in this thesis turned to an investigation of some non-price effects of expenditure reduction, in a context where adjustment redraws the boundaries between the public and private sectors, and reduces government investment in the provision of private goods, which it may have previously supplied to private agents as transfers in kind.

The main idea was that in a developing society - as indeed in most others - the degree of a person's dependence on the government varies with her position in the wealth distribution. If capital markets are imperfect, so that credit ceilings depend on initial wealth, and if there are production set non-convexities, so that projects must have a minimum size, then the poorest people may not even have access to the entrepreneurial production possibilities at all. And if, by obtaining even larger loans, people can buy private substitutes to public capital inputs, then richer groups will not depend on the government as much as poorer entrepreneurs do.

Chapter 3 found that, over a certain range, reductions in government investment in the production of these services - such as basic infrastructure, health care and education - which it supplies in a non-targeted way, will cause an increase in inequality of opportunity. The expected rates of return facing poorer people will fall further below those facing their richer counterparts, despite their being identical in every respect except initial wealth. Furthermore, it is possible that very low rates of public investment will lead to highly polarized societies, in which the middle-class (consisting of entrepreneurs able to buy private capital but dependent on the government for their complement of public capital) disappears. The high-return entrepreneurial activity is then restricted to a small group of very wealthy agents, able to provide their own infrastructure, health and education, while the bulk of society is restricted to some subsistence activity or, in alternative set-ups, supplying their labour to other entrepreneurs. In those cases, increases in government investment may have substantial positive effects on both equality of opportunity and on income per capita.

Chapter 4 looked at the role of government in such a framework in greater detail. It established the condition required for a positive optimal proportional tax rate to exist, and suggested reasons why the condition should be met under most reasonable parametric assumptions. This tax rate was found to depend positively on the relative importance of public capital in the private entrepreneurial production function, which in some sense can also represent society's view on the range of inputs which ought to be produced by the government. It depended negatively on the ratio of foreign transfers to GDP, reflecting a shift in the optimal allocation of domestic savings in response to exogenous changes in the level of foreign savings made available specifically to the production of public capital by the government. Naturally, it also depended positively on the population share of the

credit-constrained (and hence more government dependent) group.

Interestingly, in light of the World Bank's early position regarding future growth as the answer to current costs of adjustment, Chapter 5 finds that public investment cuts may not lead only to greater (but stable) inequality of opportunity at steady state. It may actually lead to ever-increasing income divergence, with group growth rates increasing with their access to private substitutes to a technology that depends on public capital. The chapter suggests that if a lower propensity to save (or to invest in education) is observed amongst the poor, this may reflect perfectly rational behaviour in the face of different opportunities, rather than any skill, talent or effort difference. Because they face barriers to accessing the most productive technologies, they face lower marginal rates of intertemporal transformation. They therefore optimally choose lower marginal rates of intertemporal substitution, and have lower savings and investment ratios. Poorer groups hence have a lower growth rate, further reinforcing the inequalities of opportunity and generating a situation of polarizing growth. The role of public expenditure - even in the production and untargeted distribution of physical and social infrastructure - as a 'social cement', capable of halting persistent increases in inequality, is emphasized.

The empirical part of the thesis suggests a different, but complementary, policy implication. While governments that care about equity - or at least equality of opportunity - should avoid excessive cuts in their investment in services useful as inputs for private agents, they should do so with due respect to proper fiscal and monetary discipline. Macroeconomic mismanagement appears to do the poor and vulnerable no good at all, even in the short run.

This conclusion arises from the end of a section which delved into nine years of a large, repeated cross-section household survey data set for Brazil, the main objectives of which were to describe and explain the trends in inequality and poverty during the 1980s. This was a turbulent decade, characterized by unprecedented macroeconomic instability, which was discussed in Chapter 6.

Chapter 7 revealed that inequality had been rising unambiguously through the decade. Although this was not a completely monotonic process, according to any of the scalar inequality measures, the trend was unmistakeable, both in terms of those measures and in

terms of Lorenz dominance. A surprisingly large number of Lorenz dominance results were found, and most proved to be statistically significant, confirming that inequality was generally rising throughout the period. Welfare results are more ambiguous, because the increase in inequality coexisted with an increase in mean (reported) income. The most remarkable welfare finding was the dominance of 1986 - the year of the Cruzado plan - over all other years in second order stochastic terms, and all but one in first order stochastic terms.

Poverty also rose during the decade, but less unequivocally. Its behaviour was more cyclical, with large increases in the recession of the early 1980s, improvements during the recovery, and new rises as the economy stagnated again towards the end of the decade. These results were generally found to be robust to the choice of equivalence scale used for comparing across households, although one would not be so sanguine if the primary interest were on poverty levels.

Chapter 8 sought explanations for these inequality trends. A static decomposition of Generalized Entropy inequality measures found that about half of the overall inequality could be 'explained' by a fine partition, according to regional location, urban-rural status, education, age, gender and race. The most important single explanatory attribute was education of the head of household - although the direction of causation can not be inferred. Race, regional location and urban-rural status also have some explanatory power. Although this was quite informative about the static structure of Brazilian inequality, the dynamic decomposition of G(0) was not able to shed much light on the causes of changes in inequality.

Continuing to search for factors behind the large increase in dispersion in the 1980s, the analysis turned to the role of macroeconomic variables, and hence to the picture of instability described earlier. Though these results are more tentative in nature, there was substantial support for the hypothesis that a high and accelerating rate of inflation is associated with increasing inequality. In particular, OLS regressions found that (generally significant) coefficients on inflation perfectly predicted the direction of changes in decile shares observed from the beginning to the end of the 1980s. The regressions and correlations confirmed that poverty behaved more cyclically. Although inflation also seemed to be positively associated with poverty, its role was secondary to those of real

wages, unemployment and growth.

Albeit through different approaches, both the theoretical and the empirical parts of this thesis emphasize the importance of the role of good and active governance for the protection of the living standards of the poor and of equality of opportunity during the economic reform process of structural adjustment. The fact that capital markets are not perfect, and that the poor are very often credit constrained, implies that governments that care about the welfare of the most vulnerable members of their societies should be careful with the extent of their transfer of activity to the private sector, or indeed with charging market prices for all of its services. There is a 'social cement' aspect to transfers in kind, which may play an important role in preventing growth from leading to ever greater inequity. Nevertheless, in keeping with tried and tested macroeconomic theory and advice, they should not finance these expenditures irresponsibly, risking macroeconomic instability. High inflation will cripple the income shares of the very people a government may be spending to help. Sound public finances and sound public investment have an important role to play in preserving equity throughout the process of economic reform, and beyond.

APPENDICES

Appendix to Chapter 2: TABLE A2-1 : World Development Reports (1980 - 1990)

Year	Main Themes	Key Figures (i) President (ii) Direction (iii) Team Leader	Comment
1980	Human Development/ Poverty	Robert McNamara Bevan Waide/Hollis Chenery Paul Isenman	Emphasises importance of education, training, nutrition and health in promoting growth and relieving poverty. Rural development theme recurs. Cautious on link from growth to poverty reduction. Promoting cause of poor both an end in itself and means to faster growth. Raises problems of policy falling victim to vested interests.
1981	Adjustment, trade and capital flows	Robert McNamara Hollis Chenery Robert Cassen	Returns to worries of the 1978 report on international economic environment. Need to expand financial flows to LDCs with little apparent concern for debt problems. Useful country studies on adjustment but macro in orientation. Some repetition of 1980 discussion on human development.
1982	Agricultural development	A.W. Clausen -- David Turnham	A rosy view of growth and adjustment of LDCs in 1970s is offered - "good use of additional borrowing". Published three months before the Mexican debt crisis broke. Saw China and India's self-sufficiency as providing insulation from international economic changes. Some mention of problems of debt burdens and higher interest rates. Emphasises link between rapid growth and rapid agricultural growth but short on evidence. Advocates reform of agricultural policy and reiterates support for small farmers. Agricultural and rural development seen as key to alleviation of rural poverty.
1983	Management in development	A.W. Clausen Anne Krueger/Peter Wright Pierre Landell-Mills	First mention of debt crisis; association with high interest rates. Speaks of 'illiquidity' and need for more capital inflows. Again mention of China and India's resilience being associated with low trade involvements. Warnings on protectionism. Beginning of emphasis on markets and outward orientation. Associates price distortions with poor performance. Working guide to issues in the management of the macroeconomy, state-owned enterprises, projects and programmes, and the public service.
1984	Population	A.W. Clausen Anne Krueger/Costas Michalopoulos Nancy Birdsall	Some pessimism about longer-term world growth appears. Links earlier 'benign' recycling of the 1970s with debt crisis. Importance of adjustment and co-ordinated international action. Externality and information arguments for population policy are advanced. Consequences of high population growth are argued to be damaging but empirical and theoretical support fairly weak.

Year	Main Themes	Key Figures (i) President (ii) Direction (iii) Team Leader	Comment
1985	International financial flows	A.W. Clausen Anne Krueger/Costas Michalopoulos Francis Colaco	Those who avoided debt crisis had growth before world market entry, expanded traded sector and diversified exports. Looks like '*ex post* wisdom' given earlier 'recycling' emphasis. Emphasis on costs of protection and price distortions. Useful guide to international financial system and some interesting simulations. Less strong on analysis.
1986	Pricing and trade in world agriculture	A.W. Clausen Anne Krueger/Costas Michalopoulos Ananderup Ray	Lower interest rates and success at bringing down inflation seen as positive developments. Importance of growth in agriculture both to combat poverty and to lead economic growth. Optimistic about potential for technological advance. Need for better pricing, infrastructure, trading regimes and research. Progress noted in dealing with famines outside Africa. Distortions in trade lead to food exports being mostly from industrialised countries.
1987	Industrialisation and foreign trade	Barber Conable Ben King/Costas Michalopoulos Sarath Rajapatirana	External payments imbalances of industrial countries are a threat to stability. Continued worrying on protectionism. Advantages of outward orientation are argued strongly. Much made of experience of East Asian countries. Conclusions from empirical work incautious.
1988	Public Finance	Barber Conable W. David Hopper/Stanley Fischer Johannes Linn	Emphasis continued on reducing external imbalances for industrial countries, restructuring for developing countries, reducing resource transfers from developing countries. For public finance in developing countries, recommendations are: prudent macro, simplified tax systems to increase revenue and reduce distortions, more control and quality in spending. Association between fiscal deficits and debtors. Useful guide to public finance for developing countries.
1989	Financial systems	Barber Conable Stanley Fischer Millard Long	Problems of financial institutions seen as arising from excessive government intervention and external shocks. Main policy recommendation is liberalisation of financial institutions. As with WDR 1988 an unambitious but useful manual on its subject.
1990	Poverty	Barber Conable Stanley Fischer Lyn Squire	Two-part strategy recommended - labour intensive growth plus provision of social services, particularly primary education, primary health care and family planning. Cross-country comparison (of limited usefulness) of poverty using universal poverty line. Little support found for Kuznets inverted U-curve. Some discussion of safety nets. Also of 'adjustment' and poverty. Presents coherent assimilation of various themes around poverty reduction.

Notes:

1. This table is adapted from Stern with Ferreira (forthcoming).
2. From 1983-85 the WDRs had as 'Principal Editor' Rupert Pennant Rea, and from 1987 Clive Crook. In 1986 John Parker was editorial adviser.

Appendix to Chapter 3

Proof of Proposition 3

Definitions:

Let $W \subseteq R^+$ be the set of all possible values for the wealth variable w, its state space.

Let Ω be the Borel algebra of W.

Let $\Phi(W, \Omega)$ be the set of all signed measures on (W, Ω); and let $\Lambda(W, \Omega)$ be the set of all probability measures in that measurable space.

Lemma A1: $\Phi(W, \Omega)$ is a vector space.

Proof: see chapter 11.3 in Stokey and Lucas (1989).

Let the total variation norm on this space be given by:

$$\|\lambda\| = \text{limsup} \sum_{i=1}^{k} \lambda(A_i) \qquad \text{(A1)}$$

where the supremum is over all finite partitions of W into disjoint measurable sets.

Following Stokey and Lucas (1989), we say that a sequence of probability measures $\{\lambda_n\}$ converges in the total variation norm to the probability measure λ if $\lim_{n\to\infty} \|\lambda_n - \lambda\| = 0$.

Let $P(w, A) = \Pr[\phi(w_t, \theta_t) \in A]$, where $P: W \times \Omega \to [0,1]$ and $\phi(w, \theta) = (1-\alpha)(1-\tau) f(w, \theta)$ is defined by equation (33) above, be a candidate transition function.

Plan:

The proof is in four steps. Step I proves that P(w, A) is a transition function. Step II defines condition M and proves that the transition function satisfies it. Step III proves that the function thus satisfies the Strong Convergence Theorem for Markov Processes in infinite state spaces (Theorem 11.12 in Stokey and Lucas (1989)). Step IV applies a Law of Large Numbers to reinterpret the expected probability measure for a lineage as the long-run cross-section distribution at period t.

Step I:

P(w, A) is a transition function iff:

a) P(w, A) is a probability measure on (W, Ω), for each w $\in$ W; and

b) P(w, A) is a Ω-measurable function for each A $\in$ Ω.

(a) is true because:

P(w, $\varnothing$) = Pr [ϕ(w, θ) $\in$ $\varnothing$] = 0, by the definition of the probability operator.

P(w, W) = Pr [ϕ(w, θ) $\in$ W] = 1, since W is the state space for all w.

P(w, A) = Pr [ϕ(w, θ) $\in$ A] $\geq$ 0 for all A $\in$ Ω, by the definition of the probability operator.

And for all disjoint B $\in$ Ω, P(w, $\cup^{\infty} B_i$) = $\sum_i^{\infty}$ P(w, B_i), because:

Pr [ϕ(w, θ) $\in$ $\cup^{\infty} B_i$] = $\sum_i^{\infty}$ Pr [ϕ(w, θ) $\in$ B_i], by the definition of the probability operator.

(b) is true because: P(w, A) = Pr [ϕ(w, θ) $\in$ A], which can be expressed as follows:

$$P(w,A) = \int_A \phi(w,\theta)\, dPr(\theta) = \int_A 1_A[\ ]\,\phi_A(w,\theta)\, dPr(\theta) \qquad \text{(A2)}$$

where 1_A is an indicator function, and ϕ_A denotes the value of ϕ when in A. But both of these functions are Ω-measurable for any A $\in$ Ω, because indicator functions are always measurable, and ϕ_A is piecewise continuous, with a finite number of discontinuities (maximum of 2) in A. Piecewise continuous real-valued functions defined on bounded intervals of real numbers (such as A), are known to be measurable in the relevant Borel algebra (see Ash, 1972, p.34). That the product of two Ω-measurable functions is itself Ω-measurable follows from Theorem 1.5.6 in Ash (1972, p.39).

Hence P(w, A) is a transition function on (W, Ω), as this step set out to prove.

Step II:

Condition M is discussed in Onicescu (1969), and proved originally by Stokey and Lucas (1989), Chapter 11.4. It states that, in the complete metric space defined by Λ(W, Ω) and the total variation norm, there exist an integer N $\geq$ 1, and a real number ε > 0, such that for any A $\in$ Ω, either P^N (w, A) > ε, for all w $\in$ W; or P^N (w, A^c) > ε, for all w $\in$ W.[1]

[1] A^c = W\A, the complement of set A in the relevant state space.

In this case, let $A = [0, \bar{w}]$. Then,

a) all $w \geq 0$, as $W \subseteq R^+$.

b) if $w > \bar{w}$, $P(w, \{0\}) = 1\text{-}q$, and $\{0\} \subset A$. This establishes that $P^N(w, A) > \varepsilon$, for w such that $q(w) < 1\text{-}\varepsilon$ (with $N = 1$). But there may be w such that $q(w) > 1\text{-}\varepsilon$. In that case, $P(w_t, \{w: w < w_t\}) = 1$. Hence, $\exists\ M,\ 1 < M < \infty$, such that $P^M(w_t, A) = 1 > \varepsilon$. This establishes for all $w > \bar{w}$, that there exist $N \in \{1, M\}$ and $\varepsilon > 0$ such that $P^N(w, A) > \varepsilon$.

c) if $w^* \leq w \leq \bar{w}$, $P(w, \{0\}) = 1\text{-}q$, and $\{0\} \subset A$.

For w such that $q(w) > 1\text{-}\varepsilon$, $P(w_t, \{w: w > w_t\}) = q$. Therefore, $\exists\ J \geq 1$ such that $P^J(w_t, A) > \varepsilon$. This is because either $w_{t+j} \in A$ or it belongs to $\{w: w > \bar{w}\}$, in which case item (b) above applies.

d) if $0 \leq w < w^*$, $P(w, A) = 1 > \varepsilon$.

Hence, for all $w \in W$, $\exists\ N \geq 1$, $\varepsilon > 0$, such that for $A = [0, \bar{w}]$, $P^N(w, A) > \varepsilon$.

P (w, A) satisfies condition M, as this step set out to prove.

Step III:

Theorem 11.12 in Stokey and Lucas (1989) establishes sufficient conditions for Strong Convergence of Markov Processes in infinite state spaces. Applied to this example, it states that: **if** (a) P is a transition function on (W, Ω); (b) T^* is the adjoint operator associated with P; and (c) P satisfies condition M for $N \geq 1$, $\varepsilon > 0$; **then** there exists a unique probability measure $\lambda^* \in \Lambda(W, \Omega)$ such that:

$$\|T^{*Nk}\lambda_0 - \lambda^*\| \leq (1 - \epsilon)^k \|\lambda_0 - \lambda^*\| \qquad \text{(A3)}$$

for all $\lambda_0 \in \Lambda(W, \Omega)$, $k = 1, 2, \ldots$

Clearly, step I establishes (a) and step II establishes (c). For the definition of the adjoint operator in (b), see Stokey and Lucas (1989, Ch 8).

To see that (A3) indeed establishes that any λ_0 converges to λ^* in the total distribution norm, note that it implies that $\lim_{k\to\infty} \|T^{*Nk}\lambda_0 - \lambda^*\| = 0$. This establishes the existence, uniqueness and stability of an invariant probability measure in the set of all probability measures in the measurable space of the state space W, to which any initial measure will converge in time through the transition function P, as this step set out to prove.

Step IV:

Because the problem was defined for a continuum of agents, λ^* can be reinterpreted as the limiting long run cross section distribution $G^*(w)$, by the law of large numbers, as this step sets out to show.

Let T be the earliest date at which every lineage in the population has converged to λ^*. At each $t > T$, there is then a continuum of agents indexed by i in $[0, \bar{w}]$, each drawing w_{it} from a distribution λ^*, such draws being independent. Let $I = [0, \bar{w}]$. Using the Kolmogorov construction, let $\mathbb{H} = \mathbb{R}^I$ be the probability space in which all possible sequences of draws may be simultaneously represented, and $\mathbb{Y}$ be its Borel algebra, derived as in Judd (1985). Finally, let $G_h(c) = l(\{i \backslash h(i) \leq c\})$, for an arbitrary $c \in \mathbb{R}$, be a sample distribution at a fixed time $t > T$. l simply denotes a Lebesgue measure.

For any Lebesgue measurable subset A of $\mathbb{R}$, and $A^t = \{h \in \mathbb{H} \backslash h(t) \in A\}$, $t \in I$, define the probability measure μ satisfying:

(i): $\mu(A^t) = \lambda^*(A)$, and

(ii): $\mu(A^{t1} \cap A^{t2} \cap \ldots \cap A^{tn}) = \mu(A^{t1}) \times \mu(A^{t2}) \times \ldots \times \mu(A^{tn})$; $t_i \in I$, $t_i \neq t_j$ for $i \neq j$, $n = 1, 2, \ldots$

Then the law of large numbers which allows us to state that the cross-section distribution of realized draws on the support $[0, \bar{w}]$ is λ^*, is given as follows:

$\mu(\{h \setminus G_h(.) = \lambda^*(.)\}) = 1$.

Theorem (1) in Judd (1985) proves that $N = \{h \in \mathbb{H} \setminus G_h \text{ fails to exist}\}$ is not μ-measurable, but for any $r \in [0,1]$, there exists an extension of μ, μ_r, such that $\mu_r(N) = r$. We choose $r = 0$, so N is a set of measure zero. Therefore G_h exists a.e. in $\mathbb{H}$. We call $\mu_0 = \mu_0$.

Theorem (2) in Judd (1985) proves that $L = \{h \setminus G_h \text{ exists and } G_h = \lambda^*\}$ is not μ_0-measurable, but there are extensions of μ_0 for which G_h exists almost surely and $G_h = \lambda^*$ holds with probability χ, any $\chi \in [0, 1]$. We choose $\mu^* = \mu_0(\chi)$ when $\chi = 1$.

Hence $G^* = G_h(w) = \lambda^*$ with probability 1. The law of large numbers can be stated, and it is true. This allows us to reinterpret the lineage probability measure λ^* as the long run

cross-section distribution G*(w), as this step set out to show.

Therefore, $G_t(w)$ converges to a unique invariant distribution G* from any initial $G_0(w)$.

■

Appendix to Chapter 4

This appendix proves that the individually preferred tax rate for upper class agents (i.e. those able to purchase private public capital, since their wealth w > w**) is zero for $w \geq \mu$.

We know that:

$$\tau_u^*(\omega) = \frac{a(\omega - g_p)}{\omega} - \frac{(1-a)(X+g_p)}{\mu} \qquad \text{(A1)}$$

where, at the optimal input ratio, $g_p(\omega) = a\omega - (1\text{-}a)g_g$.

We are looking for ω_0, so that $\tau_u^*(\omega_0) = 0$.

But in that case, $g_g = \tau\mu + X = X$.

Setting (A1) equal to zero and substiuting for g_p, we have:

$$\frac{a[\omega - a\omega + (1-a)X]}{\omega} = \frac{(1-a)[X + a\omega - (1-a)X]}{\mu}$$

$$a\mu[(1-a)(\omega + X)] = (1-a)\omega[a\omega + aX]$$

$$a(1-a)(\omega + X)\mu = a(1-a)(\omega + X)\omega$$

$$\omega = \mu$$

This proves that $\tau_i^*(\mu) = 0$. But $\tau_i^*(w > \mu) = 0$ because of inequality (16) and the constraint that $0 \leq \tau_i^* < 1$. QED.

Appendix to Chapter 5

This appendix states the proof of proposition 1, that in the two period version of the model presented above, type 2 households invest more than type 1 households: $k_1^2 > k_1^1$.

The constrained optimization problem facing type 2 households, as stated in (4), can be rewritten as:

$$Max \quad \frac{[\Phi(k_0,g_0) - k_1^2]^{1-\sigma} + (Ak_1^2)^{1-\sigma} - 2}{1-\sigma} \tag{A1}$$

The FOC wrt k_1^2 is given by:

$$\frac{-(1-\sigma)[\Phi(k_0,g_0) - k_1^2]^{-\sigma} + (1-\sigma)(Ak_1^2)^{-\sigma}A}{(1-\sigma)} = 0 \qquad i.e. \tag{A2}$$

$$\Phi(k_0,g_0) - k_1^2 = A^{\frac{\sigma-1}{\sigma}} k_1^2 \tag{A3}$$

And therefore:

$$k_1^2 = \frac{\Phi(k_0,g_0)}{1 + A^{\frac{\sigma-1}{\sigma}}} \tag{A4}$$

The equivalent problem for type 1 households is to

$$Max \quad \frac{[\Phi(k_0,g_0) - k_1^1]^{1-\sigma} + [\Phi(k_1^1,g_1)]^{1-\sigma} - 2}{1 - \sigma} \tag{A5}$$

The FOC wrt k_1^1 is:

$$\frac{-(1-\sigma)[\Phi(k_0,g_0) - k_1^1]^{-\sigma} + (1-\sigma)[\Phi(k_1^1,g_1)]^{-\sigma}\Phi_1(k_1^1,g_1)}{1 - \sigma} = 0 \tag{A6}$$

To solve explicitly for k_1^1, it becomes necessary at this stage to introduce a specific functional form for $\Phi(k,g)$. The Cobb Douglas form (with parameter β, $0 < \beta < 1$) is consistent with the assumptions made in A1, compatible with the assumptions of Chapter 3, and has the advantage of commonality. We adopt it in what follows, to obtain:

$$[k_0^{\beta} g_0^{1-\beta} - k_1^1]^{-\sigma} = [k_1^{1\beta} g_1^{1-\beta}]^{-\sigma} \beta k_1^{1\beta-1} g_1^{1-\beta} \tag{A7}$$

$$k_0^{\beta} g_0^{1-\beta} = k_1^1 + g_1^{1-\beta} (\beta g_1^{1-\beta})^{-\frac{1}{\sigma}} k_1^{1\frac{1-\beta+\beta\sigma}{\sigma}} \tag{A8}$$

which eventually gives:

$$k_1^1 = \frac{k_0^{\beta} g_0^{1-\beta}}{1 + g_1^{1-\beta} (\beta g_1^{1-\beta})^{-\frac{1}{\sigma}} k_1^{1\frac{(1-\beta)(1-\sigma)}{\sigma}}} \tag{A9}$$

Therefore:

$$k_1^2 > k_1^1 \quad \textit{iff} \quad A^{\frac{\sigma-1}{\sigma}} < g_1^{1-\beta} (\beta g_1^{1-\beta})^{-\frac{1}{\sigma}} k_1^{1\frac{(1-\beta)(1-\sigma)}{\sigma}} \tag{A10}$$

This necessary and sufficient condition can be restated as:

$$A > g_1^{1-\beta} k_1^{1\beta-1} \beta^{\frac{1}{1-\sigma}} \tag{A11}$$

But:

$$A > \beta g_1^{1-\beta} k_1^{1\beta-1} = \Phi_1(k_1^1, g_1) > \beta^{\frac{1}{1-\sigma}} g_1^{1-\beta} k_1^{1\beta-1} \tag{A12}$$

where the first inequality follows from assumption A5, and second from the fact that

$$\beta > \beta^{\frac{1}{1-\sigma}} \qquad \textit{since} \quad 0 < \beta \,,\, \sigma < 1 \tag{A13}$$

Therefore,

$$k_1^2 > k_1^1 \tag{A14}$$

as we set out to prove. ■

Appendix A to Chapter 7

Table A1: Description of variables in the basic PNAD household questionnaire, 1981-1990.

Variable and Short definition	Year									
	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981
v101 Household identifier	v101	v101	v101	v101	v101	v101	v101	v101	v101	v101
v10 State	v10	v10	v10	v10	v10	v10	v10	v10	v10	v10
v3 urban or rural	v3	v3	v3	v3	v3	v3	v3	v3	v3	v3
v5 type of area	v5	v5	v5	v5	v5	v5	v5	v5	v5	v5
v9991 frequency wgt (ind)	v9991	v9991	v9991	v9991	v9991	v9991	v9991	v9991	v9991	v9991
v9981 frequency wgt (hh)	v9981	v9981	v9981	v9981	v9981	v9981	v9981	v9981	v9981	v9981
v9971 frequency wgt (family)	v9971	v9971	v9971	v9971	v9971	v9971	v9971	v9971	v9971	v9971
v100 type of observation	v100	v100	v100	v100	v100	v100	v100	v100	v100	v100
Household level data										
v107 total household size	v107	v107	v107	v107	v107	v107	v107	v107	v107	v107
v108 no of inds aged 10+	v108	v108	v108	v108	v108	v108	v108	v108	v108	v108
v201 type of household (a)	v201	v201	v201	v201	v201	v201	v201	v201	v201	v201
v202 type of household (b)	v202	v202	v202	v202	v202	v202	v202	v202	v202	v202
v203 walls	v203	v203	v203	v203	v203	v203	v203	v203	v203	v203
v204 floor	v204	v204	v204	v204	v204	v204	v204	v204	v204	v204
v205 roof	v205	v205	v205	v205	v205	v205	v205	v205	v205	v205
v206 water	v206	v206	v206	v206	v206	v206	v206	v206	v206	v206
v207 sewage disposal	v207	v207	v207	v207	v207	v207	v207	v207	v207	v207
v208 bathroom access	v208	v208	v208	v208	v208	v208	v208	v208	v208	v208
v209 rubbish disposal	v209	v209	v209	v209	v209	v209	v209	v209	v209	v209
v210 electric light	v210	v210	v210	v210	v210	v210	v210	v210	v210	v210
v211 no of rooms	v211	v211	v211	v211	v211	v211	v211	v211	v211	v211
v231 no of bedrooms	v231	v231	v231	v231	v231	v231	v231	v231	v231	v231
v212 tenure status	v212	v212	v212	v212	v212	v212	v212	v212	v212	v212
v213 monthly rent/mortgage	v213	v213	v213	v213	v213	v213	v213	v213	v213	v213
v214 filter	v214	v214	v214	v214	v214	v214	v214	v214	v214	v214
v215 stove	v215	v215	v215	v215	v215	v215	v215	v215	v215	v215
v216 fridge	v216	v216	v216	v216	v216	v216	v216	v216	v216	v216

v217 radio	v217	v217	v217	v217	v217	v217	v217	v217	v217	v217
v218 tv	v218	v218	v218	v218	v218	v218	v218	v218	v218	v218
v409 type of construction	v409	v409	v409	v409	v409	v409	v409	v409	v409	v409
v410 total monthly income	v410	v410	v410	v410	v410	v410	v410	v410	v410	v410
v411 household income -class	v411	v411	v411	v411	v411	v411	v411	v411	v411	v411
v412 persons/ room	v412	v412	v412	v412	v412	v412	v412	v412	v412	v412
v413 persons/ room - class	v413	v413	v413	v413	v413	v413	v413	v413	v413	v413
v414 persons/ bedroom	v414	v414	v414	v414	v414	v414	v414	v414	v414	v414
v415 persons/ bedroom- class	v415	v415	v415	v415	v415	v415	v415	v415	v415	v415
Individual level data										
v303 sex	v303	v303	v303	v303	v303	v303	v303	v303	v303	v303
v304 colour	v304	v304	v304	v304	v304	v2301	v2301	-	v6302	-
v304 absent/present	-	-	-	-	-	v304	v304	v304	v304	v304
v305 position in household	v305	v305	v305	v305	v305	v305	v305	v305	v305	v305
v306 position in family	v306	v306	v306	v306	v306	v306	v306	v306	v306	v306
v307 number of families	v307	v307	v307	v307	v307	v307	v307	v307	v307	v307
v308 day of birth	v308	v308	v308	v308	v308	v308	v308	v308	v308	v308
v309 month of birth	v309	v309	v309	v309	v309	v309	v309	v309	v309	v309
v310 year of birth	v310	v310	v310	v310	v310	v310	v310	v310	v310	v310
v805 age	v805	v805	v805	v805	v805	v805	v805	v805	v805	v805
v311 literacy - yes/no	v311	v311	v311	v311	v311	v311	v311	v311	v311	v311
v312 year of schooling (in attendance)	v312	v312	v312	v312	v312	v312	v312	v312	v312	v312
v314 level of schooling (in attendance)	v314	v314	v314	v314	v314	v314	v314	v314	v314	v314
v315 year of schooling (last achieved)	v315	v315	v315	v315	v315	v315	v315	v315	v315	v315
v317 level of schooling (last achieved)	v317	v317	v317	v317	v317	v317	v317	v317	v317	v317
v501 activity	v501	v501	v501	v501	v501	v501	v501	v501	v501	v501
v502 other job - yes/no	v502	v502	v502	v502	v502	v502	v502	v502	v502	v502
v503 occupation	v503	v503	v503	v503	v503	v503	v503	v503	v503	v503
v504 job sector - narrow def	v504	v504	v504	v504	v504	v504	v504	v504	v504	v504
v505 position in occupation	v505	v505	v505	v505	v505	v505	v505	v505	v505	v505
v506 labour ID card - yes/no	v506	v506	v506	v506	v506	v506	v506	v506	v506	v506
v5070 money income - yes/no	v5070	v5070	v5070	v5070	v5070	v5070	v5070	v5070	v5070	v5070
v537 money income - amount	v537	v537	v537	v537	v537	v537	v537	v537	v537	v537
v547 money income - class	v547	v547	v547	v547	v547	v547	v547	v547	v547	v547
v5071 income in kind - yes/no	v5071	v5071	v5071	v5071	v5071	v5071	v5071	v5071	v5071	v5071

v538 income in kind - value	v538	v538	v538	v538	v538	v538	v538	v538	v538	v538
v548 income in kind - class	v548	v548	v548	v548	v548	v548	v548	v548	v548	v548
v5072 payment only in kind - y/n	v5072	v5072	v5072	v5072	v5072	v5072	v5072	v5072	v5072	v5072
v508 hours normally worked	v508	v508	v508	v508	v508	v508	v508	v508	v508	v508
v5090 money income (2nd job) - y/n	v5090	v5090	v5090	v5090	v5090	v5090	v5090	v5090	v5090	v5090
v549 money income (2nd job) - amount	v549	v549	v549	v549	v549	v549	v549	v549	v549	v549
v559 money income (2nd job) - class	v559	v559	v559	v559	v559	v559	v559	v559	v559	v559
v5091income in kind (2nd job) - y/n	v5091	v5091	v5091	v5091	v5091	v5091	v5091	v5091	v5091	v5091
v550 income in kind (2nd job) - amount	v550	v550	v550	v550	v550	v550	v550	v550	v550	v550
v560 income in kind (2nd job) - class	v560	v560	v560	v560	v560	v560	v560	v560	v560	v560
v5092 payment only in kind - y/n	v5092	v5092	v5092	v5092	v5092	v5092	v5092	v5092	v5092	v5092
v5093 paid at all	v5093	v5093	v5093	v5093	v5093	v5093	v5093	v5093	v5093	v5093
v510 hours normally worked (2nd job)	v510	v510	v510	v510	v510	v510	v510	v510	v510	v510
v511 pay social security - y/n	v511	v511	v511	v511	v511	v511	v511	v511	v511	v511
v512 which social security	v512	v512	v512	v512	v512	v512	v512	v512	v512	v512
v513 were job seeker (ref month)	v513	v513	v513	v513	v513	v513	v513	v513	v513	v513
v514 were job seeker (2 months)	v514	v514	v514	v514	v514	v514	v514	v514	v514	v514
v515 job seeking method	v515	v515	v515	v515	v515	v515	v515	v515	v515	v515
v516 length of unemployment (months)	-	v516	v516	v516	v516	v516	v516	v516	v516	v516
v566 length of unemployment (weeks)	-	v566	v566	v566	v566	v566	v566	v566	v566	v566
v517 previously worked - paid	-	v517	v517	v517	v517	v517	v517	v517	v517	v517
v518 previously worked - unpaid	-	v518	v518	v518	v518	v518	v518	v518	v518	v518
v519 how long out of labour force - years	-	v519	v519	v519	v519	v519	v519	v519	v519	v519
v569 how long out of labour force - months	-	v569	v569	v569	v569	v569	v569	v569	v569	v569
v520 previous occupation	-	v520	v520	v520	v520	v520	v520	v520	v520	v520
v521 sector - narrow def	-	v521	v521	v521	v521	v521	v521	v521	v521	v521
v522 position in previous job	-	v522	v522	v522	v522	v522	v522	v522	v522	v522
v523 duration of previous job (years)	-	v523	v523	v523	v523	v523	v523	v523	v523	v523
v573 duration of previous job (months)	-	v573	v573	v573	v573	v573	v573	v573	v573	v573
v524 reason for leaving	-	v524	v524	v524	v524	v524	v524	v524	v524	v524
v525 labour ID card - prev. job	-	v525	v525	v525	v525	v525	v525	v525	v525	v525
v526 occupational pension - prev. job	-	v526	v526	v526	v526	v526	v526	v526	v526	v526
v527 receipt of other income	-	v527	v527	v527	v527	v527	v527	v527	v527	v527
v5280 receive retirement pension	-	v5280	v5280	v5280	v5280	v5280	v5280	v5280	v5280	v5280
v578 retirement pension - amount	-	v578	v578	v578	v578	v578	v578	v578	v578	v578

v588 retirement pension - class	-	v588	v588	v588	v588	v588	v588	v588	v588	v588
v5281 receive occupational pension	-	v5281	v5281	v5281	v5281	v5281	v5281	v5281	v5281	v5281
v579 amount	-	v579	v579	v579	v579	v579	v579	v579	v579	v579
v589 class	-	v589	v589	v589	v589	v589	v589	v589	v589	v589
v5282 receive 'abono permanente'	-	v5282	v5282	v5282	v5282	v5282	v5282	v5282	v5282	v5282
v580 amount	-	v580	v580	v580	v580	v580	v580	v580	v580	v580
v590 class	-	v590	v590	v590	v590	v590	v590	v590	v590	v590
v5283 receive rent	-	v5283	v5283	v5283	v5283	v5283	v5283	v5283	v5283	v5283
v581 amount	-	v581	v581	v581	v581	v581	v581	v581	v581	v581
v591 class	-	v591	v591	v591	v591	v591	v591	v591	v591	v591
v5284 receive other income	-	v5284	v5284	v5284	v5284	v5284	v5284	v5284	v5284	v5284
v582 amount	-	v582	v582	v582	v582	v582	v582	v582	v582	v582
v592 class	-	v592	v592	v592	v592	v592	v592	v592	v592	v592
v806 age group (a)	v806	v806	v806	v806	v806	v806	v806	v806	v806	v806
v807 age group (b)	v807	v807	v807	v807	v807	v807	v807	v807	v807	v807
v808 age group (c)	v808	v808	v808	v808	v808	v808	v808	v808	v808	v808
v318 years of education	v318	v318	v318	v318	v318	v318	v318	v318	v318	v318
v319 education - level	v319	v319	v319	v319	v319	v319	v319	v319	v319	v319
v600 monthly income, main job	v600	v600	v600	v600	v600	v600	v600	v600	v600	v600
v601 monthly income, all jobs	v601	v601	v601	v601	v601	v601	v601	v601	v601	v601
v602 monthly income, all sources	v602	v602	v602	v602	v602	v602	v602	v602	v602	v602
v603 income, all sources, class (a)	v603	v603	v603	v603	v603	v603	v603	v603	v603	v603
v604 income, all sources, class (b)	v604	v604	v604	v604	v604	v604	v604	v604	v604	v604
v605 income, all jobs, class	v605	v605	v605	v605	v605	v605	v605	v605	v605	v605
v606 income, main job, class	v606	v606	v606	v606	v606	v606	v606	v606	v606	v606
v607 total family income, class	v607	v607	v607	v607	v607	v607	v607	v607	v607	v607
v5080 hours worked - class	v5080	v5080	v5080	v5080	v5080	v5080	v5080	v5080	v5080	v5080
v5040 occupational sector	v5040	v5040	v5040	v5040	v5040	v5040	v5040	v5040	v5040	v5040
v5100 total hours worked	v5100	v5100	v5100	v5100	v5100	v5100	v5100	v5100	v5100	v5100
v5101 total hours worked, class	v5101	v5101	v5101	v5101	v5101	v5101	v5101	v5101	v5101	v5101
v5050 position in occupation	v5050	v5050	v5050	v5050	v5050	v5050	v5050	v5050	v5050	v5050
v5030 occupational group	v5030	v5030	v5030	v5030	v5030	v5030	v5030	v5030	v5030	v5030
v9329 no of people in family	v9329	v9329	v9329	v9329	v9329	v9329	v9329	v9329	v9329	v9329
v9330 no of workers in family	v9330	v9330	v9330	v9330	v9330	v9330	v9330	v9330	v9330	v9330
v5010 family income	v5010	v5010	v5010	v5010	v5010	v5010	v5010	v5010	v5010	v5010

SECRETARIA DE PLANEJAMENTO E COORDENAÇÃO DA PRESIDÊNCIA DA REPÚBLICA
FUNDAÇÃO INSTITUTO BRASILEIRO DE GEOGRAFIA E ESTATÍSTICA — IBGE
DIRETORIA DE PESQUISAS
Departamento de Emprego e Rendimento

PESQUISA NACIONAL POR AMOSTRA DE DOMICÍLIOS — PNAD

PESQUISA BÁSICA DE 1989

PNAD 1.01 — QUESTIONÁRIO DE MÃO-DE-OBRA

Nº DO SETOR | SITUAÇÃO | 1 | 1 Nº DE ORDEM (de 1 a 8 na PNAD 2.02 ou 2.03) | 2 Nº DE CONTROLE | 3 Nº DE SÉRIE

NOME DO MUNICÍPIO

4 SEMANA | 5 UNIDADE ADICIONAL: 2 ☐ É; 4 ☒ Não é

6 TIPO DE ENTREVISTA

TIPO A — UNIDADE OCUPADA: 01 ☐ Realizada; 02 ☐ Fechada; 03 ☐ Recusa; 04 ☐ Outra
TIPO B — UNIDADE VAGA: 05 ☐ Em condições de ser habitada; 06 ☐ Uso ocasional; 07 ☐ Em construção ou reforma; 08 ☐ Em ruínas
TIPO C — UNIDADE INEXISTENTE: 09 ☐ Demolida; 10 ☐ Não foi encontrada; 11 ☐ Não residencial; 12 ☐ Fora do setor

MORADORES: 7 TOTAL | 8 10 ANOS OU MAIS
QUESTIONÁRIO SUPLEMENTAR: ☐ Não tem; ☐ Tem
Nº DE FOLHAS INTERNAS

Unidade de Federação .....
Endereço .....
Data da entrevista ___/___/___ Assinatura do informante .....

2 PARA DOMICÍLIO

1 ESPÉCIE DO DOMICÍLIO
2 ☐ Particular permanente
4 ☐ Particular improvisado
6 ☐ Coletivo

PARA DOMICÍLIO PARTICULAR PERMANENTE

2 TIPO
1 ☐ Casa; 5 ☐ Rústico; 3 ☐ Apartamento; 7 ☐ Quarto ou cômodo

3 PAREDE
0 ☐ Alvenaria; 6 ☐ Madeira aproveitada; 2 ☐ Madeira aparelhada; 8 ☐ Outra; 4 ☐ Taipa não revestida

4 PISO
1 ☐ Madeira aparelhada; 6 ☐ Terra; 3 ☐ Cimento; 7 ☐ Madeira aproveitada; 5 ☐ Cerâmica; 8 ☐ Outro

5 COBERTURA
0 ☐ Laje de concreto; 6 ☐ Madeira aparelhada; 2 ☐ Telha de barro; 7 ☐ Madeira aproveitada; 4 ☐ Zinco; 8 ☐ Outra

6 ABASTECIMENTO DE AGUA
Com canalização interna: 1 ☐ Rede geral; 2 ☐ Poço ou nascente; 3 ☐ Outra forma
Sem canalização interna: 4 ☐ Rede geral; 5 ☐ Poço ou nascente; 6 ☐ Outra forma

7 ESGOTAMENTO SANITARIO
0 ☐ Rede geral; 4 ☐ Fossa rudimentar; 1 ☐ Rio, lago ou mar
2 ☐ Fossa séptica; 6 ☐ Outro; 3 ☐ Não tem

8 USO DA INSTALAÇÃO SANITÁRIA
1 ☐ Só do domicílio; 5 ☐ Sem instalação
3 ☐ Comum a mais de um domicílio; 9 ☐ Não tem

9 DESTINO DO LIXO
0 ☐ Coletado; 5 ☐ Colocado em terreno baldio
2 ☐ Queimado; 8 ☐ Outro
4 ☐ Enterrado

10 ILUMINAÇÃO ELETRICA: 1 ☐ Tem; 3 ☐ Não tem
11 COMODOS: Total ☐☐; Servindo de dormitório ☐☐
12 CONDIÇÃO DE OCUPAÇÃO
0 ☐ Próprio — já acabou de pagar; 4 ☐ Alugado
2 ☐ Próprio — não acabou de pagar; 6 ☐ Cedido; 8 ☐ Outra
13 ALUGUEL OU PRESTAÇÃO MENSAL: NCz$ ☐☐☐☐,00; 999999 ☐ Não paga
14 FILTRO: 1 ☐ Tem; 3 ☐ Não tem
15 FOGÃO: 2 ☐ Tem; 4 ☐ Não tem
16 GELADEIRA: 1 ☐ Tem; 3 ☐ Não tem
17 RADIO: 2 ☐ Tem; 4 ☐ Não tem
18 TELEVISÃO: 1 ☐ Tem; 3 ☐ Não tem

3 PARA MORADORES

Nº DE ORDEM	NOME	SEXO 1-Homem 3-Mulher	COR (ver códigos)	CONDIÇÃO na Unidade Domiciliar (ver códigos)	CONDIÇÃO na Família (ver códigos)	DATA DE NASCIMENTO Dia	Mês	Ano	Sabe Ler e Escrever 1-Sim 3-Não	PARA PESSOAS DE 5 ANOS OU MAIS: Freqüenta Escola (série e grau do curso que freqüenta) Série	Grau Nome	Grau Código	Não Freqüenta Escola (curso de grau mais elevado no qual concluiu pelo menos a primeira série) Última série concluída	Grau da última série concluída Nome	Grau da última série concluída Código	Espécie do Curso (que freqüenta ou freqüentou)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)
01																	
02																	
03																	
04																	
05																	
06																	
07																	
08																	
09																	
10																	
11																	

CÓDIGOS

COR: 2 – Branca; 6 – Parda; 4 – Preta; 8 – Amarela

CONDIÇÃO NA UNIDADE DOMICILIAR E NA FAMÍLIA: 1 – Chefe; 3 – Filho; 5 – Agregado; 7 – Empregado doméstico; 2 – Cônjuge; 4 – Outro parente; 6 – Pensionista; 8 – Parente do empregado doméstico

OBSERVAÇÕES

4 NOME DO MORADOR DE 10 ANOS OU MAIS

1 Nº DE ORDEM ☐☐

1 O que fez na semana de 24 a 30 de setembro?
1 ☐ Trabalhou
2 ☐ Tinha trabalho mas não trabalhou (siga 2)
3 ☐ Procurou trabalho (passe ao 15)
4 ☐ Era estudante
5 ☐ Cuidou dos afazeres domésticos
6 ☐ Era aposentado ou pensionista
7 ☐ Outra (especifique) (passe ao 13)

2 tinha mais de um trabalho na semana de 24 a 30 de setembro?
1 ☐ Sim; 3 ☐ Não (siga 3)

OS QUESITOS 3 A 8 DEVEM REFERIR-SE AO TRABALHO QUE A PESSOA DECLAROU MAIOR NÚMERO DE HORAS NA SEMANA DE REFERÊNCIA

3 Qual a ocupação que exercia no trabalho que tinha na semana de 24 a 30 de setembro? (siga 4)

4 Onde ... exercia o trabalho que tinha na semana de 24 a 30 setembro? (siga 5)

5 No trabalho que tinha na semana de 24 a 30 de setembro, era:
1 ☐ Empregado
2 ☐ Parceiro empregado
3 ☐ Trabalhador agrícola volante com intermediário
4 ☐ Trabalhador agrícola volante sem intermediário (siga 6)
5 ☐ Conta-própria
6 ☐ Parceiro conta-própria
7 ☐ Empregador
8 ☐ Parceiro empregador (passe ao 7)
0 ☐ Não remunerado (passe ao 8)

6 Nesse emprego, tinha carteira de trabalho assinada?
2 ☐ Sim; 4 ☐ Não (siga 7)

7 Qual o rendimento mensal que ... ganhava normalmente no trabalho que tinha na semana de 24 a 30 de setembro?
2 ☐ NCz$ ☐☐☐☐,00 Em dinheiro
4 ☐ NCz$ ☐☐☐☐,00 Em produtos ou mercadorias
6 ☐ Somente em benefícios (siga 8)

8 Quantas horas trabalhava normalmente por semana no trabalho que tinha na semana de 24 a 30 de setembro? ☐☐ Horas
(se "sim" no quesito 2, siga 9. Caso contrário, passe ao 11)

9 Qual o rendimento mensal que ganhava normalmente no(s) outro(s) trabalho(s) que tinha na semana de 24 a 30 de setembro?
1 ☐ NCz$ ☐☐☐☐,00 Em dinheiro
3 ☐ NCz$ ☐☐☐☐,00 Em produtos ou mercadorias
5 ☐ Somente em benefícios
7 ☐ Não remunerado (siga 10)

10 Quantas horas trabalhava normalmente por semana no(s) outro(s) trabalho(s) que tinha na semana de 24 a 30 de setembro? ☐☐ Horas (siga 11)

11 era contribuinte de instituto de previdência?
1 ☐ Sim (siga 12); 3 ☐ Não (passe ao 27)

12 contribuía para instituto de previdência federal, estadual ou municipal?
2 ☐ Federal; 4 ☐ Estadual; 6 ☐ Municipal (passe ao 27)

13 tomou alguma providência para conseguir trabalho no período de 1 a 23 de setembro?
1 ☐ Sim (passe ao 15); 3 ☐ Não (siga 14)

14 tomou alguma providência para conseguir trabalho no período de 2 a 31 de agosto?
2 ☐ Sim (siga 15); 4 ☐ Não (passe ao 27)

15 Qual a providência que tomou para conseguir trabalho?
1 ☐ Consultou empregadores
2 ☐ Fez concurso
3 ☐ Consultou agência ou sindicato
4 ☐ Colocou ou respondeu anúncio
5 ☐ Consultou parente, amigo ou colega
6 ☐ Outra (especifique) (siga 16)
7 ☐ Nenhuma (passe ao 27)

16 Em 30 de setembro de 1989, fazia quanto tempo que estava procurando trabalho? ☐☐ Meses Semanas (siga 17)

17 já trabalhou anteriormente com remuneração?
2 ☐ Sim (passe ao 19); 4 ☐ Não (siga 18)

18 já trabalhou anteriormente sem remuneração?
1 ☐ Sim; 3 ☐ Não (passe ao 27)

19 Em 30 de setembro de 1989, fazia quanto tempo que saiu do último trabalho remunerado que teve? ☐☐ Anos ☐☐ Meses (siga 20)

20 Qual foi a última ocupação remunerada que exerceu? (siga 21)

21 Onde exerceu o último trabalho remunerado que teve? (siga 22)

22 No último trabalho remunerado que teve, era
2 ☐ Empregado (siga 23)
4 ☐ Conta-própria
6 ☐ Empregador (passe ao 27)

23 Durante quanto tempo trabalhou no último emprego que teve? ☐☐ Anos ☐☐ Meses (siga 24)

24 saiu do último emprego que teve por que pediu para sair ou foi dispensado?
1 ☐ Pediu para sair; 3 ☐ Foi dispensado (siga 25)

25 Nesse último emprego, tinha carteira de trabalho assinada?
2 ☐ Sim (siga 26); 4 ☐ Não (passe ao 27)

26 Quando saiu do último emprego que teve, recebeu fundo de garantia?
1 ☐ Sim; 3 ☐ Não (siga 27)

27 recebia normalmente rendimentos de aposentadoria, pensão, abono de permanência, aluguel, doação, juros de caderneta de poupança, dividendos ou outro qualquer?
2 ☐ Sim (siga 28)
4 ☐ Não (encerre a entrevista)

28 Qual o rendimento mensal que recebia normalmente de
1 ☐ NCz$ ☐☐☐☐,00 Aposentadoria
2 ☐ NCz$ ☐☐☐☐,00 Pensão
3 ☐ NCz$ ☐☐☐☐,00 Abono de permanência
4 ☐ NCz$ ☐☐☐☐,00 Aluguel
5 ☐ NCz$ ☐☐☐☐,00 Outros (especifique)

OBSERVAÇÕES

Appendix B to Chapter 7

This appendix lists the formulae for the inequality and poverty measures used in this chapter. The notation is standard:

n:	number of individuals in the sample;
y_i:	gross per capita household income for individual i, $i \in (1, 2,...,n)$;
$\mu(y) = (1/n) \sum y_i$	arithmetic mean income;
z:	poverty line for the relevant region.

Inequality measures:

The Gini coefficient is given by:

$$G = \frac{1}{2n^2\mu(y)} \sum_{i=1}^{n} \sum_{j=1}^{n} |y_i - y_j| \qquad \text{(A1)}$$

The Theil index is given by:

$$T = \frac{1}{n} \sum_{i=1}^{n} \frac{y_i}{\mu(y)} \log \frac{y_i}{\mu(y)} \qquad \text{(A2)}$$

The Coefficient of Variation is given by:

$$CV = \frac{1}{\mu(y)} \left[\frac{1}{n} \sum_{i=1}^{n} (y_i - \mu(y))^2 \right]^{1/2} \qquad \text{(A3)}$$

Poverty Measures:

The three poverty indices reported in this chapter can be expressed in the form:

$$P = \frac{1}{n} \sum_{i=1}^{n} \left[\max\left(1 - \frac{y_i}{z}, 0\right) \right]^{\alpha} \qquad \text{(A4)}$$

P is the Headcount Index when $\alpha = 0$, the Normalized Poverty Deficit when $\alpha = 1$, and the Foster-Greer-Thorbecke (2) index when $\alpha = 2$.

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